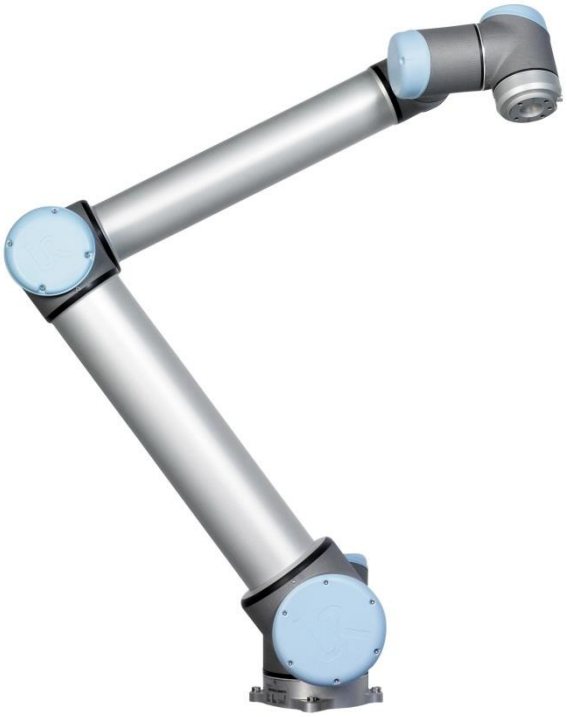
UNIVERSAL ROBOTS



Service Manual

Revision UR10_en_2.0.2

Robot:
UR10 with CB2-controller

Contents

1. General information

1.1 Purpose

The main purpose of this manual is to help the user safely perform service related operations and troubleshooting.

Universal Robots industrial robots are designed using high quality components designed for long lifetime. However any improper use of robot can potentially cause failures on the robot. For example, the robot may have been overloaded on an overrun or it may have been dropped on the floor when relocating or have run with a load not recommended by Universal Robots. Any improper use of the robot will invalidate the guarantee.

Universal Robots recommends that you do not attempt repair, adjustment or other intervention in the mechanical or electrical systems of the robot unless a problem has arisen. Any unauthorized intervention will invalidate the guarantee. Service related operations and troubleshooting should only be performed by qualified personnel

Before performing service related operations, always make sure to stop the robot program and disconnect supply to any potential dangerous tool attached on the robot arm and in the work cell.

In the event of a defect, Universal Robots recommends ordering new parts from the Universal Robot distributor from where the robot has been purchased.
Alternatively, you can order parts from your nearest distributor, whose details you can obtain from Universal Robots official website at www.universal-robots.com

1.2 Company details

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1.3 Disclaimer

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2. Preventive Maintenance

2.1 Controller

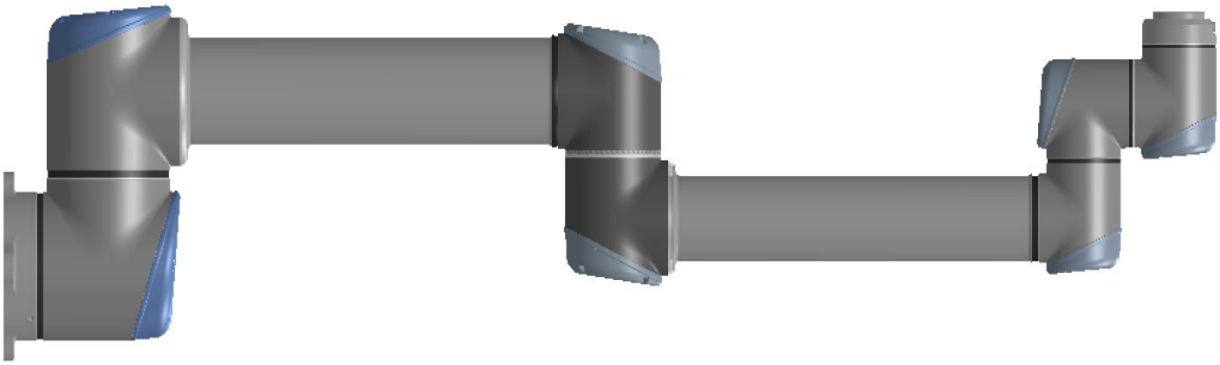
2.1.1 Visual inspection

- Disconnect power cable from controller.
- Open cabinet door.
- Check connectors are properly inserted on printed circuit boards.
- Check for any dirt/dust inside of controller.
- If any dirt/dust is present:
  - » gently use vacuum cleaning for removing particles.

2.1.2 Cleaning and replacement of filters

- Controller box contains two filters, one on each side of controller.
- Remove filters from controller box and clean them thoroughly using compressed air.
  » Replace filters if necessary.

2.2 Robot arm



2.2.1 Visual inspection

- Move robot arm to HOME position (if possible).
- Turn off and disconnect power cable from controller.
- Inspect cable between controller and robot arm for any damages.
- Inspect flat rings for wear and damages.
  - » replace flat rings if worn out or damaged.
- Inspect blue lids on all joints for any cracks or damages.
  - » replace blue lids if cracked or damaged.
- Inspect that screws for blue lids are in place and properly tightened.
  - » Replace screws, tighten properly if necessary.

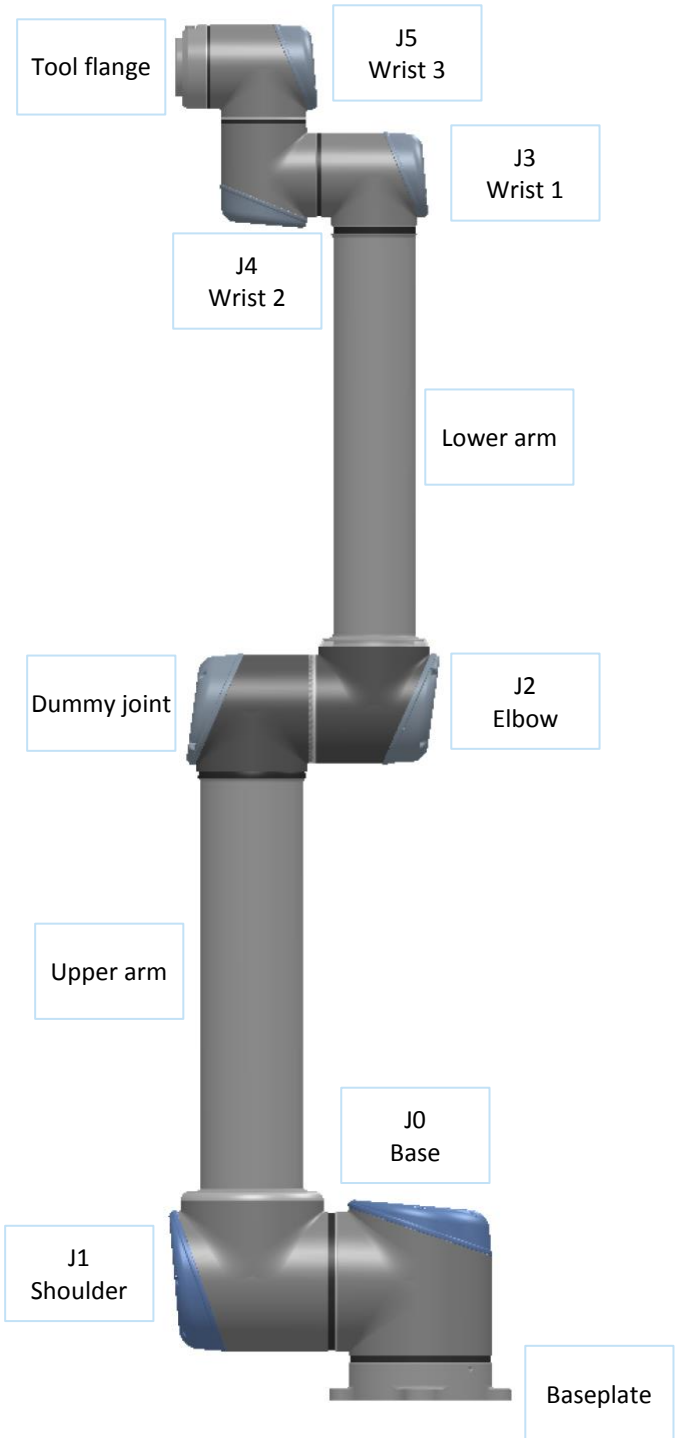
Correct torque value for screws on blue lids are 0.5Nm

If any damages are observed on a robot within the warranty period, contact the distributor from where the robot has been purchased.

3. Service and Replacement of parts

3.1 Robot arm

3.1.1 Robot arm configuration



3.1.2 Brake release

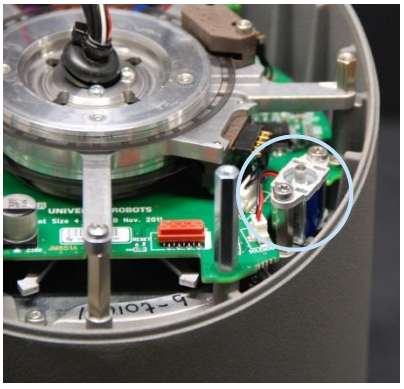
If required, the brake on a joint can be released without power connected.

IMPORTANT NOTICE:

- Before releasing a brake it is extremely important to dismount any dangerous tooling for avoiding any hazardous situations.
- If releasing the brake on Base joint, Shoulder joint or Elbow joint, it is important to make proper mechanical support prior to releasing the brake.
- Always make sure no personnel are located under the arm when releasing the brake.
- Do not move the joint more than necessary, absolute max. is 180 degrees in order for the robot to find its original physical position.

Procedure for releasing the joint

- Shut down Controller.
- Remove blue lid on joint.
- Push pin brake down for releasing, joint can then be rotated.



Brake on Base, Shoulder and Wrist joints

Brake on Elbow joint

- Make sure to mount blue lid properly on joint before turning on Controller.

3.1.3 Replacement of base plate

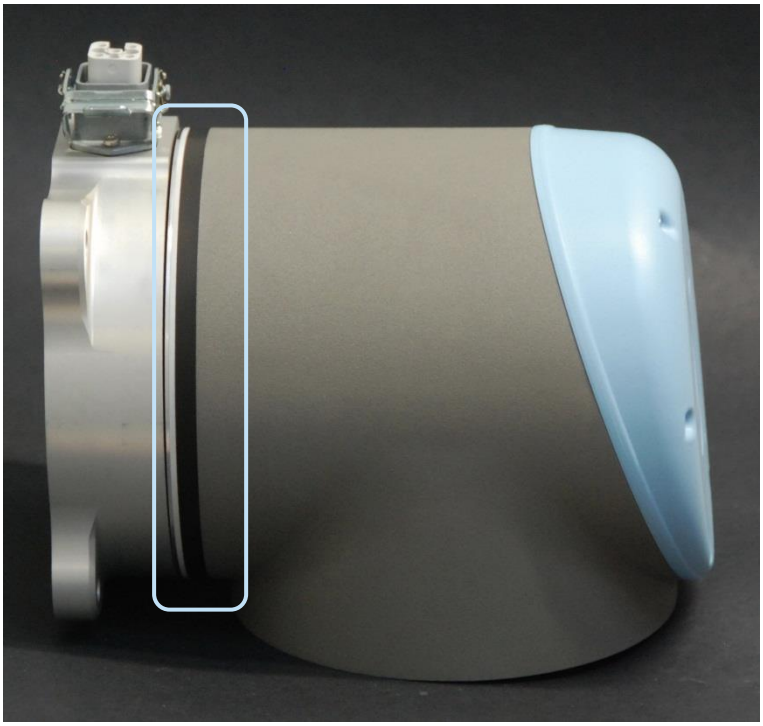
How to replace base plate

- Move robot to a comfortable position for replacing the base. If necessary dismount entire robot arm from work cell and place arm on solid surface.

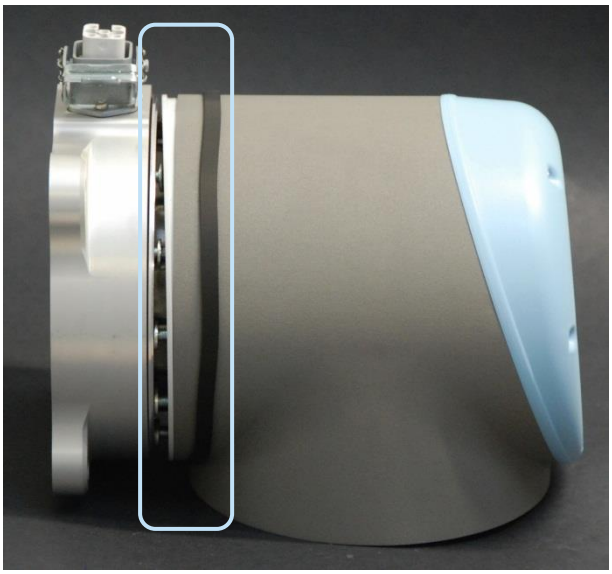
- Shut down the controller.

- Remove grease plug.

- Gently remove black flexible flat ring with a tiny screwdriver or similar tool and twist it around the joint housing.

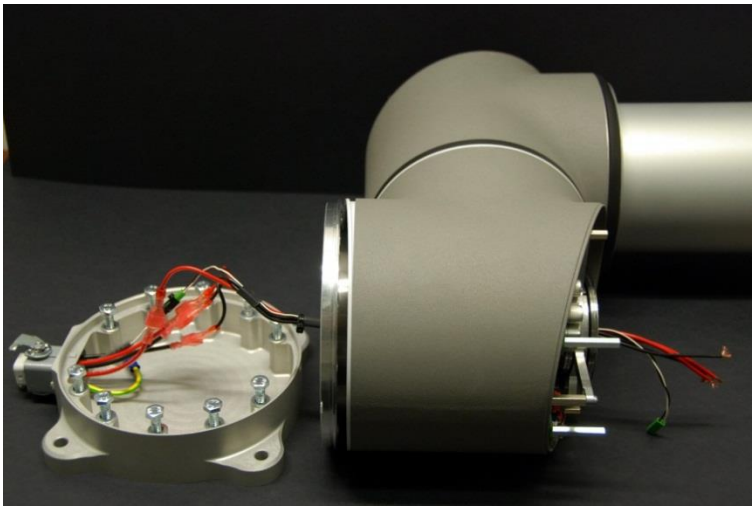


- Slide the grey Teflon ring apart.
  10 screws become visible, 5 on each side of joint.
  Untighten gently the screw with a 7 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.



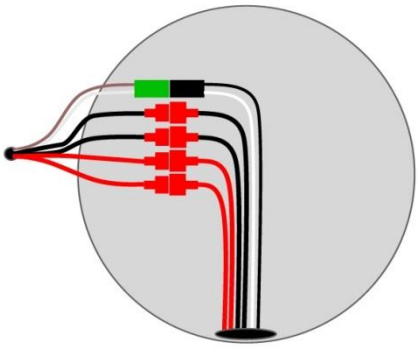
- Pull the base plate and Base joint apart and gently twist the two parts in opposite directions around 10 mm. until a mechanical stop is met (holes are keyhole-type).

- Pull away the base plate from Base joint.

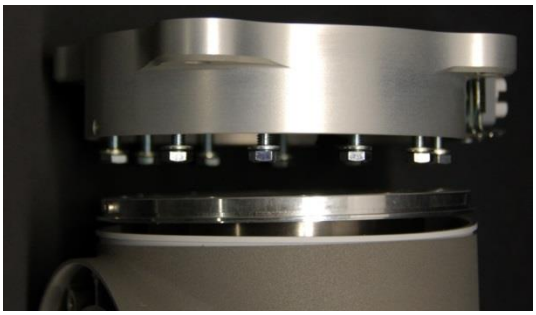


- Disconnect wires between base plate and Base joint.
  2 x red wire = 48V DC
  2 x black wire = GND
  Black/green conn. = bus cable

- Replace base plate and reconnect wires according to illustration:



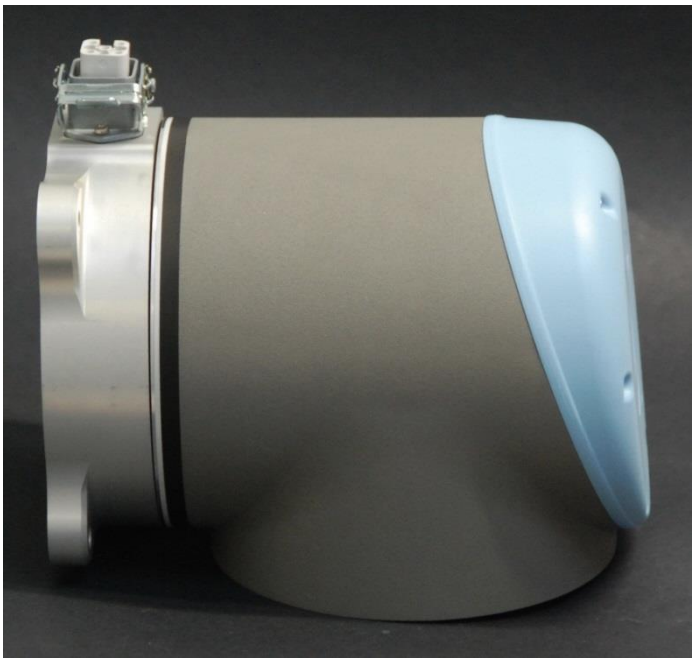
- Gently insert base plate with screws and washers into the Base joint.



- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting the base plate and Base joint in opposite directions until a mechanical stop is met.

- Tighten the 10 screws lightly, then tighten in cross order with 8Nm.

- Slide the grey Teflon ring in place and gently put back the flat ring on top of the Teflon ring.

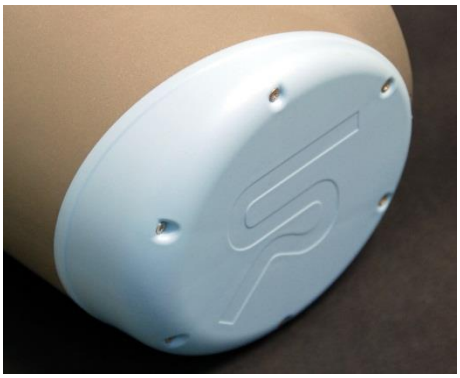


- Mount the grease plug and tighten with 0.8Nm.

3.1.4 Replacement of Base joint

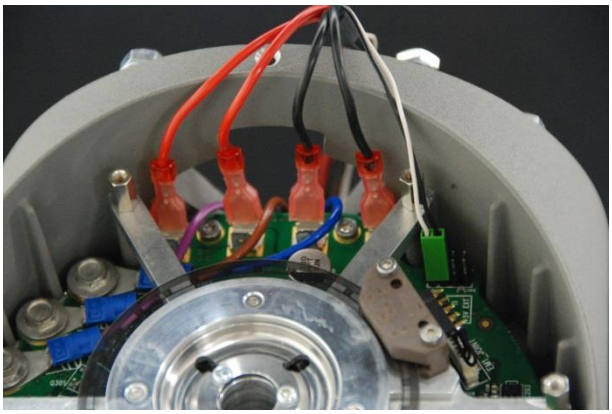
How to replace Base joint

- Move robot to a comfortable position for replacing the joint. If necessary dismount entire robot arm from work cell and place arm on solid surface.
- Shut down the controller.
- For separating base plate from Base joint, consult chapter 3.1.3 Replacement of base plate.
- Remove blue lid on Base joint.



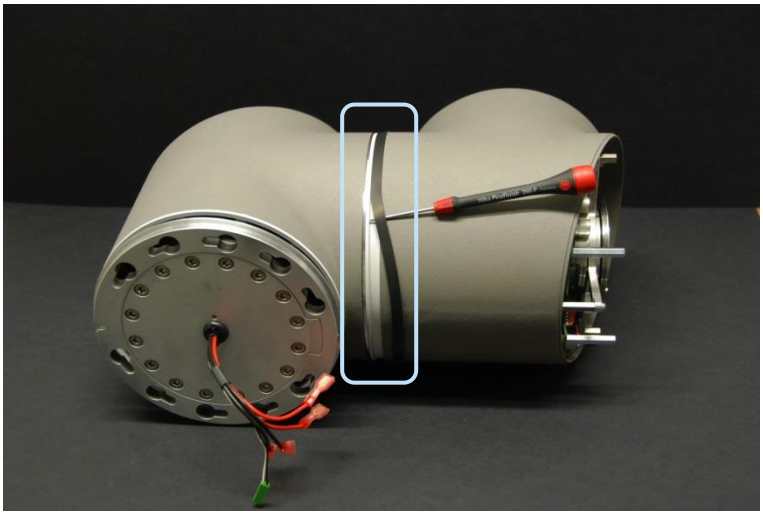
- Disconnect wires between Base joint and Shoulder joint

  2 x red wire = 48V DC
  2 x black wire = GND
  Green connector = bus cable

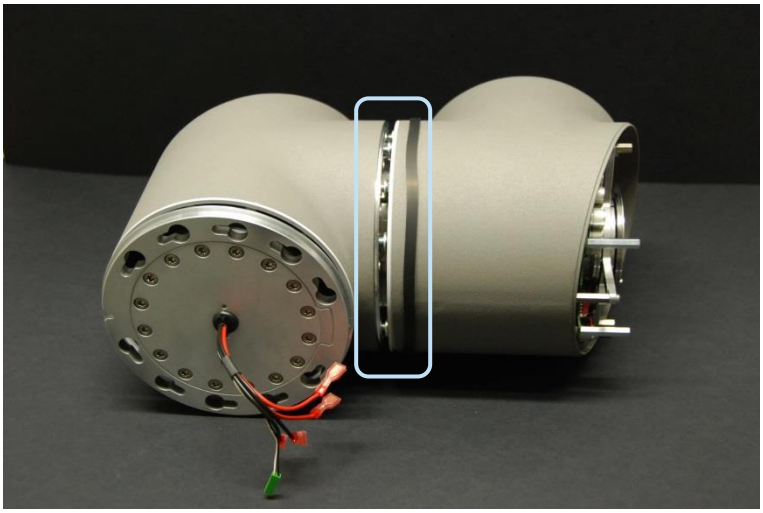


- Remove grease plug at Shoulder joint.

- Gently remove black flexible flat ring between Base and Shoulder with a tiny screwdriver or similar tool and twist it around the joint housing.

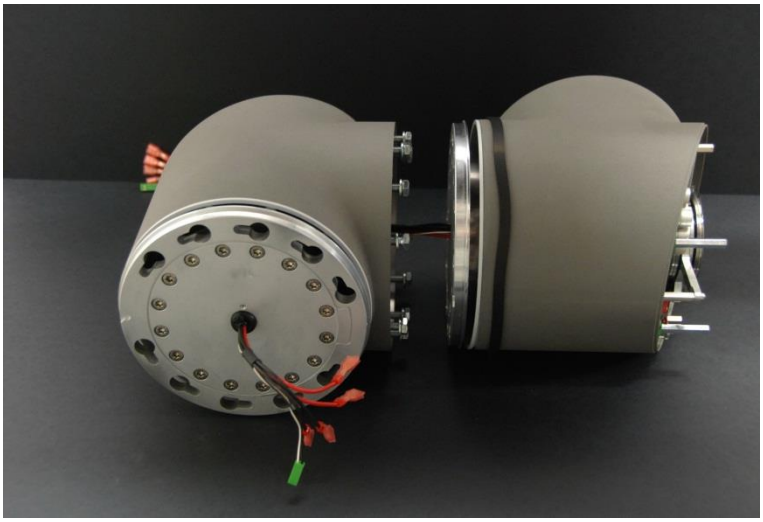


- Slide the grey Teflon ring apart.
  10 screws become visible, 5 on each side of joint.
  Untighten gently the screw with a 7 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.

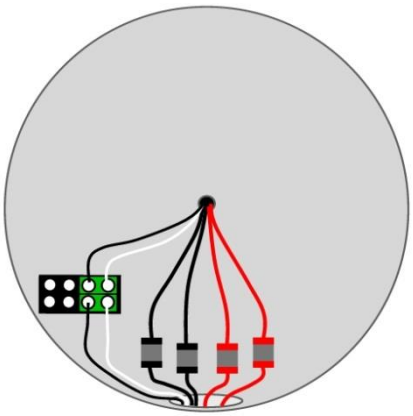


- Pull the Base joint and Shoulder joint apart and gently twist the two parts in opposite directions around 10 mm. until a mechanical stop is met (holes are keyhole-type).

- Pull away the Base joint from Shoulder joint.



- Replace Base joint and gently insert Base joint with screws and washers into the Shoulder joint.
- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting the Base joint and Shoulder joint in opposite directions until a mechanical stop is met.
- Tighten the 10 screws lightly, then tighten in cross order with 8Nm.
- Slide the grey Teflon ring in place and gently put back the flat ring on top of the Teflon ring.
- Mount the grease plug and tighten with 0.8Nm.
- Reconnect connectors as illustrated.

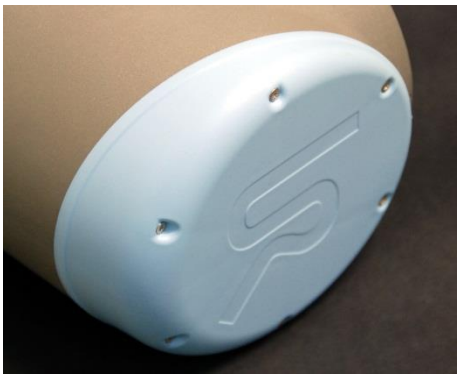


- Mount blue lid on Base joint and tighten with 0.5Nm.
- Proceed to chapter 3.1.11 Joint calibration for calibrating the joint.

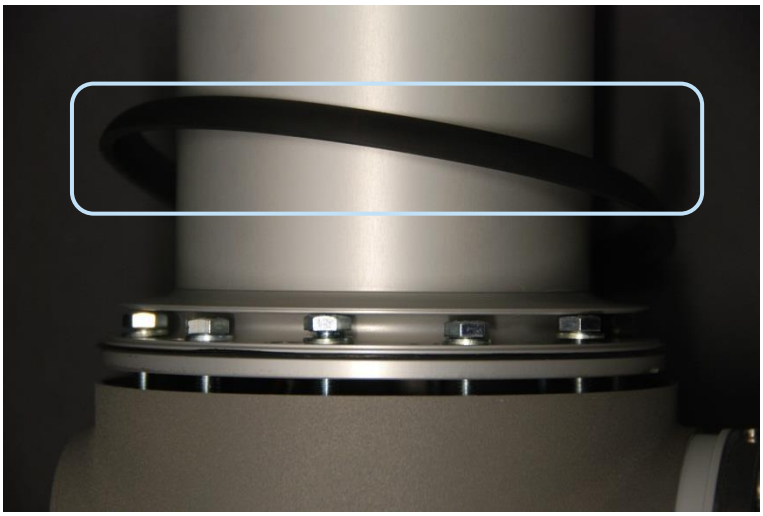
3.1.5 Replacement of Shoulder joint

How to replace Shoulder joint

- Move robot to a comfortable position for replacing the joint. If necessary dismount entire robot arm from work cell and place arm on solid surface.
- Shut down the controller.
- For separating Base joint from Shoulder joint, consult chapter 3.1.4 Replacement of Base joint.
- Remove blue lid on Shoulder joint.



- Disconnect wires between Shoulder joint and upper arm
  1 x red wire = 48V DC
  1 x black wire = GND
  Green connector = bus cable
- Gently remove black flexible gasket between Shoulder and upper arm with a tiny screwdriver or similar tool and twist it around the upper arm.



- 10 screws become visible, 5 on each side of joint.
  Untighten gently the screw with a 10 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.

- Pull the Shoulder joint and upper arm apart and gently twist the two parts in opposite directions around 10 mm. until a mechanical stop is met (holes are keyhole-type).

- Pull away the Shoulder joint from upper arm.

- Replace Shoulder joint and gently insert Shoulder joint with screws and washers into the upper arm.

- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting the Shoulder joint and upper arm in opposite directions until a mechanical stop is met.

- Tighten the 10 screws lightly, then tighten in cross order with 8Nm.

- Gently put back the gasket.

- Mount the grease plug and tighten with 0.8Nm.

- Reconnect wires correctly.

- Mount blue lid on Shoulder joint and tighten with 0.5Nm.

- Proceed to chapter 3.1.11 Joint calibration for calibrating the joint.

3.1.6 Replacement of Elbow joint

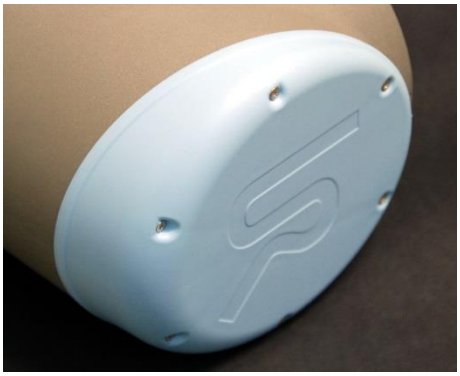
How to replace Elbow joint

- Move robot to a comfortable position for replacing the joint. If necessary dismount entire robot arm from work cell and place arm on solid surface.

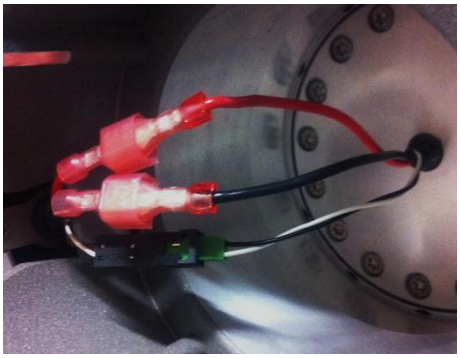
- Shut down the controller.

- Procedure for separating upper arm from Elbow joint is similar to separation of upper arm and Shoulder joint, consult chapter 3.1.5 Replacement of Shoulder joint.

- Remove blue lid on dummy joint.

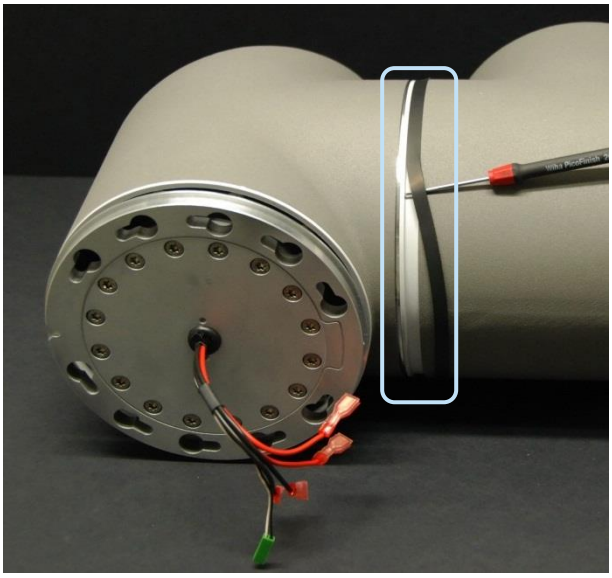


- Disconnect wires between Elbow joint and dummy joint
  1 x red wire = 48V DC
  1 x black wire = GND
  Green connector = bus cable

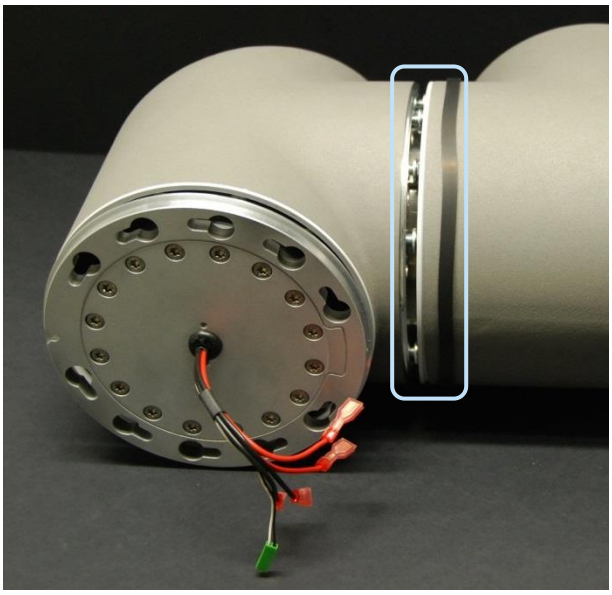


- Remove grease plug at Elbow joint.

- Gently remove black flexible flat ring between Elbow and dummy joint with a tiny screwdriver or similar tool and twist it around the joint housing.

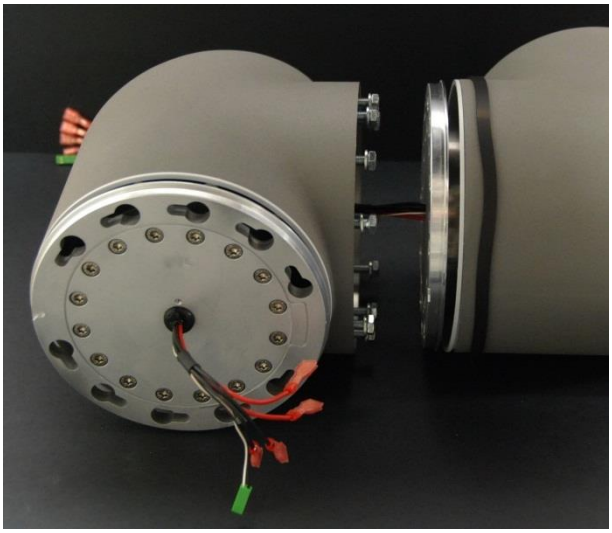


- Slide the grey Teflon ring apart.
  10 screws become visible, 5 on each side of joint.
  Untighten gently the screw with a 7 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.

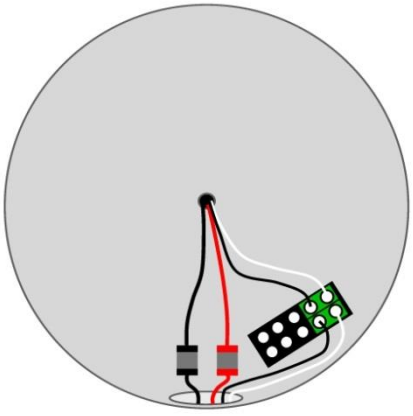


- Pull Elbow joint and dummy joint apart and gently twist the two parts in opposite directions around 10 mm. until a mechanical stop is met (holes are keyhole-type).

- Pull away the Elbow joint from dummy joint.



- Replace Elbow joint and gently insert Elbow joint with screws and washers into the dummy joint.
- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting the Elbow joint and dummy joint in opposite directions until a mechanical stop is met.
- Tighten the 10 screws lightly, then tighten in cross order with respectively 3Nm.
- Slide the grey Teflon ring in place and gently put back the flat ring on top of the Teflon ring.
- Mount the grease plug and tighten with 0.8Nm.
- Reconnect connectors as illustrated.



- Mount blue lid on Elbow joint and tighten with 0.5Nm.
- Proceed to chapter 3.1.11 Joint calibration for calibrating the joint.

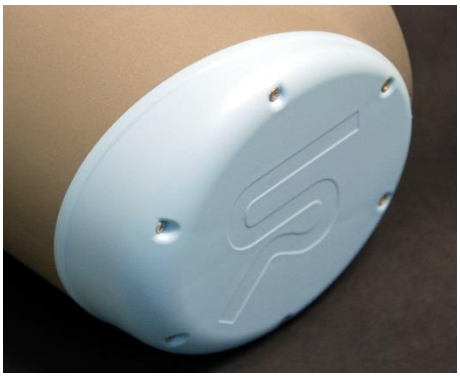
3.1.6 Replacement of Wrist 1 joint

How to replace Wrist 1 joint

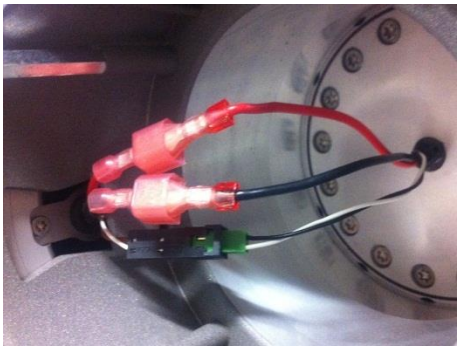
- Move robot to a comfortable position for replacing the joint. If necessary dismount entire robot arm from work cell and place arm on solid surface.

- Shut down the controller.

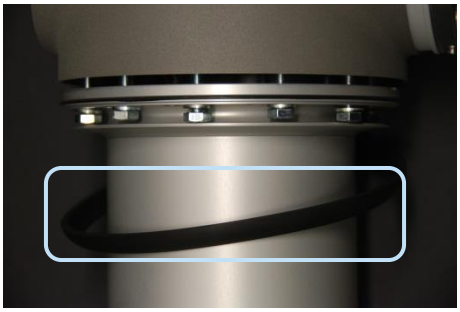
- Remove blue lid on Wrist 1 joint.



- Disconnect wires between lower arm and Wrist 1 joint.
  1 x red wire = 48V DC
  1 x black wire = GND
  Green connector = bus cable



- Gently remove black flexible gasket between lower arm and Wrist 1 joint with a tiny screwdriver or similar tool and twist it around the lower arm.



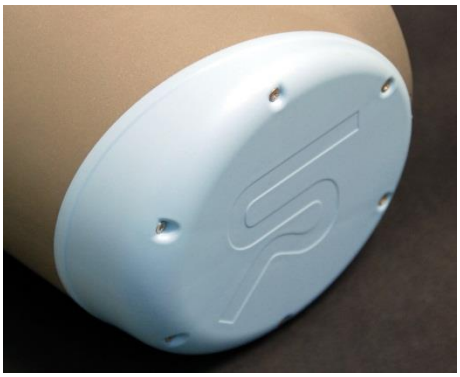
- 10 screws become visible, 5 on each side of joint.
  Untighten gently the screws with a 5.5 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.

- Pull the lower arm and Wrist 1 joint apart and gently twist the two parts in opposite directions around 8 mm. until a mechanical stop is met (holes are keyhole-type).

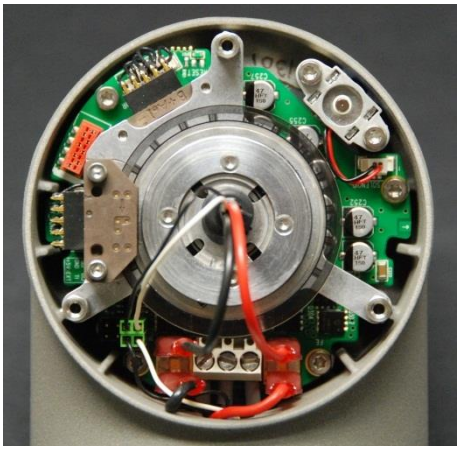
- Pull away the lower arm from Wrist 1 joint.

➢ Lower arm and Wrist 1 joint has now been separated, proceed for separating Wrist 1 from Wrist 2.

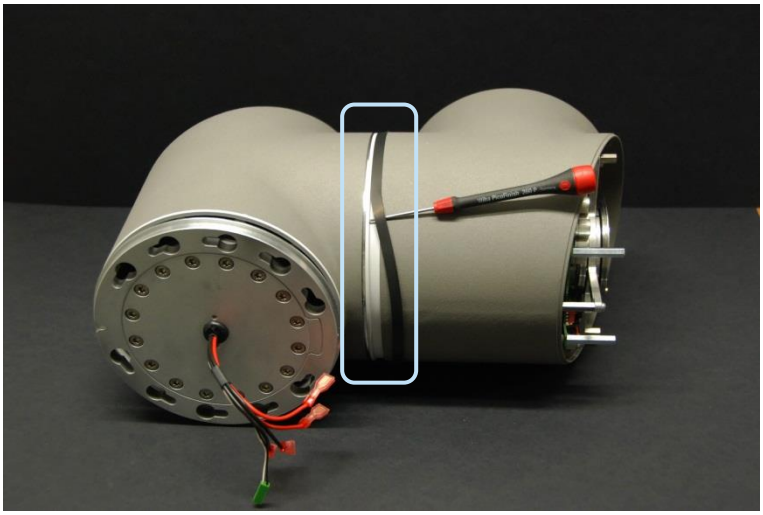
- Remove blue lid on Wrist 2 joint.



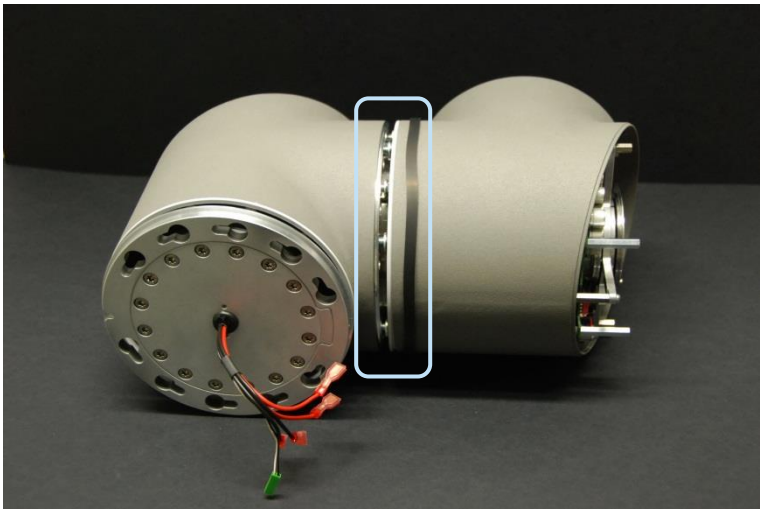
- Disconnect wires between Wrist 1 joint and Wrist 2 joint
  1 x red wire = 48V DC
  1 x black wire = GND
  Green connector = bus cable



- Gently remove black flexible flat ring between Wrist 1 and Wrist 2 with a tiny screwdriver or similar tool and twist it around the joint housing.

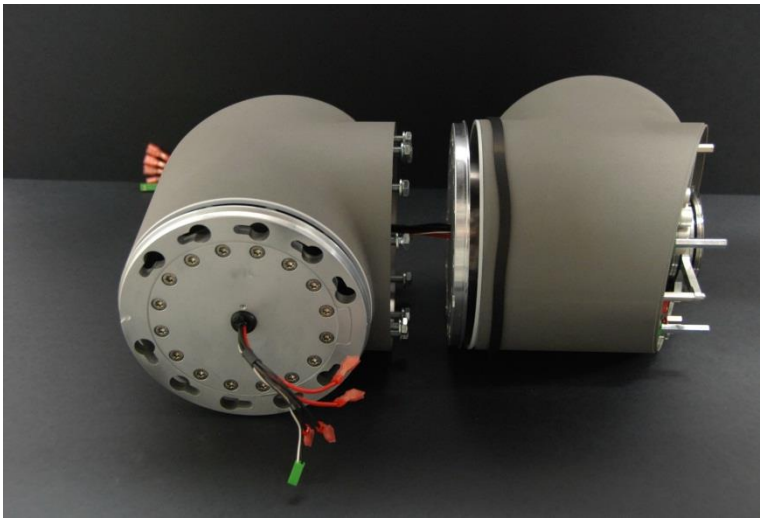


- Slide the grey Teflon ring apart.
  10 screws become visible, 5 on each side of joint.
  Untighten gently the screws with a 5.5 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.



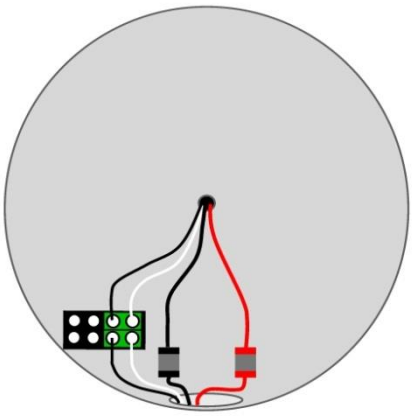
- Pull Wrist 1 joint and Wrist 2 joint apart and gently twist the two parts in opposite directions around 8 mm. until a mechanical stop is met (holes are keyhole-type).

- Pull away Wrist 1 joint from Wrist 2 joint.



➢ Wrist 1 joint and Wrist 2 joint has now been separated, proceed for assembling new Wrist 1 joint with Wrist 2 joint.

- Replace Wrist 1 and gently insert Wrist 1 joint with screws and washers into Wrist 2 joint.
- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting Wrist 1 joint and Wrist 2 joint in opposite directions until a mechanical stop is met.
- Tighten the 10 screws lightly, then tighten in cross order with 1.3Nm.
- Slide the grey Teflon ring in place and gently put back the flat ring on top of the Teflon ring.
- Mount the grease plug and tighten with 0.8Nm.
- Replace Wrist 1 and reconnect connectors as illustrated into Wrist 2.



- Mount blue lid on Wrist 2 joint and tighten with 0.5Nm.

➢ New Wrist 1 joint and Wrist 2 joint has now been assembled, proceed for assembling new Wrist 1 joint and lower arm.

- Gently insert Wrist 1 joint with screws and washers into the lower arm.
- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting Wrist 1 joint and lower arm in opposite directions until a mechanical stop is met.
- Tighten the 10 screws lightly, then tighten in cross order with 1.3Nm.
- Gently put back the gasket.
- Mount the grease plug and tighten with 0.8Nm.
- Reconnect wires between lower arm and Wrist 1 joint correctly.
- Mount blue lid on Wrist 1 joint and tighten with 0.5Nm.
- Proceed to chapter 3.1.11 Joint calibration for calibrating the joint.

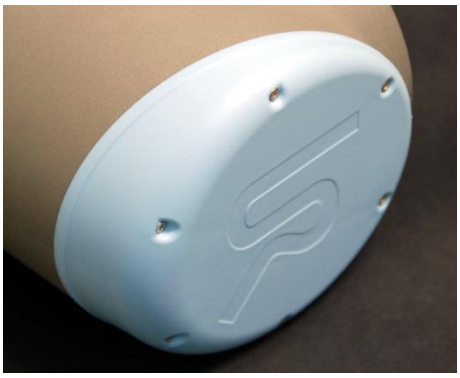
3.1.7 Replacement of Wrist 2 joint

How to replace Wrist 2 joint

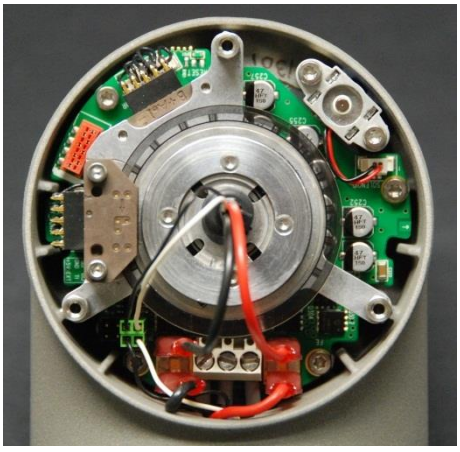
- Move robot to a comfortable position for replacing the joint. If necessary dismount entire robot arm from work cell and place arm on solid surface.

- Shut down the controller.

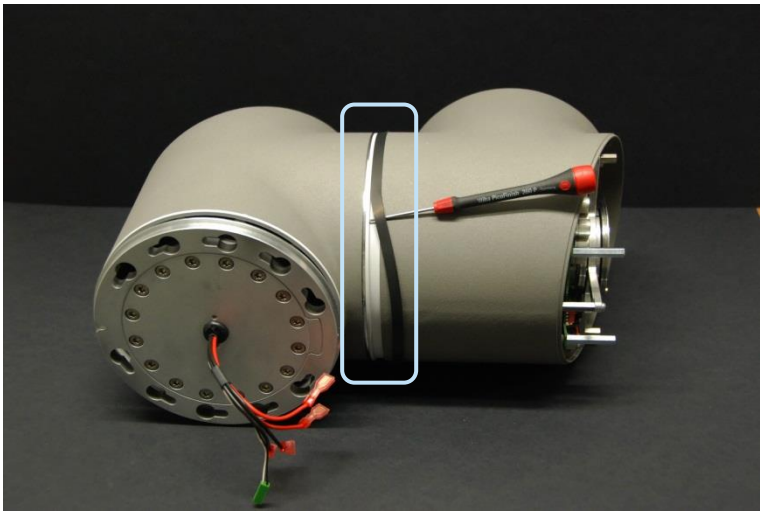
- Remove blue lid on Wrist 2 joint.



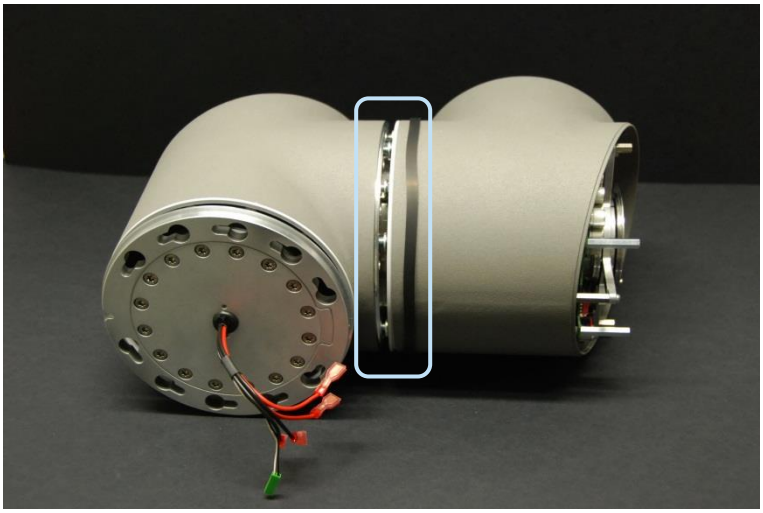
- Disconnect wires between Wrist 1 joint and Wrist 2 joint
  2 x red wire = 48V DC
  2 x black wire = GND
  Green connector = bus cable



- Gently remove black flexible flat ring between Wrist 1 and Wrist 2 with a tiny screwdriver or similar tool and twist it around the joint housing.

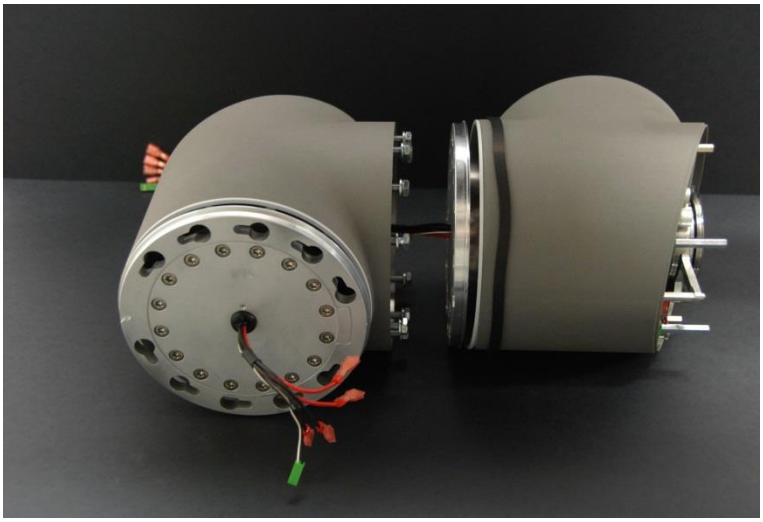


- Slide the grey Teflon ring apart.
  10 screws become visible, 5 on each side of joint.
  Untighten gently the screws with a 5.5 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.



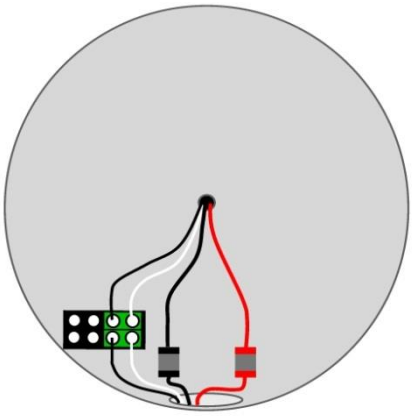
- Pull Wrist 1 joint and Wrist 2 joint apart and gently twist the two parts in opposite directions around 8 mm. until a mechanical stop is met (holes are keyhole-type).

- Pull away Wrist 1 joint from Wrist 2 joint.



➢ Wrist 1 joint and Wrist 2 joint has now been separated. Perform same procedure for separating Wrist 2 joint and Wrist 3 joint and proceed when done.

- Replace Wrist 2 and gently insert Wrist 1 joint with screws and washers into Wrist 2 joint.
- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting the Wrist 1 joint and Wrist 2 joint in opposite directions until a mechanical stop is met.
- Tighten the 10 screws lightly, then tighten in cross order with 1.3Nm.
- Slide the grey Teflon ring in place and gently put back the flat ring on top of the Teflon ring.
- Mount the grease plug and tighten with 0.8Nm.
- Reconnect connectors as illustrated into Wrist 2.



- Mount blue lid on Wrist 2 joint and tighten with 0.5Nm.

➢ Wrist 1 joint and Wrist 2 joint has now been assembled. Perform same procedure for assembling Wrist 2 joint and Wrist 3 joint.

- Proceed to chapter 3.1.11 Joint calibration for calibrating the joint.

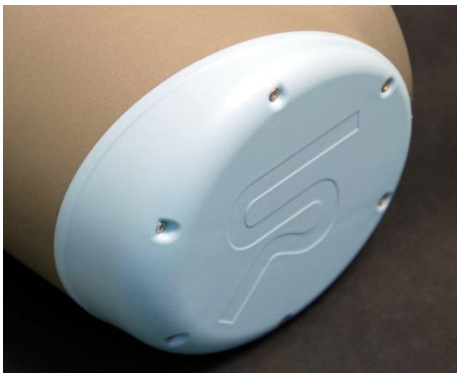
3.1.8 Replacement of Wrist 3 joint

How to replace Wrist 3 joint

- Move robot to a comfortable position for replacing the joint. If necessary dismount entire robot arm from work cell and place arm on solid surface.

- Shut down the controller.

- Remove blue lid on Wrist 3 joint.

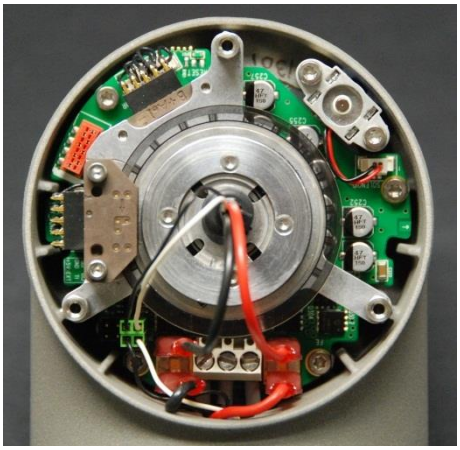


- Disconnect wires between Wrist 2 joint and Wrist 3 joint

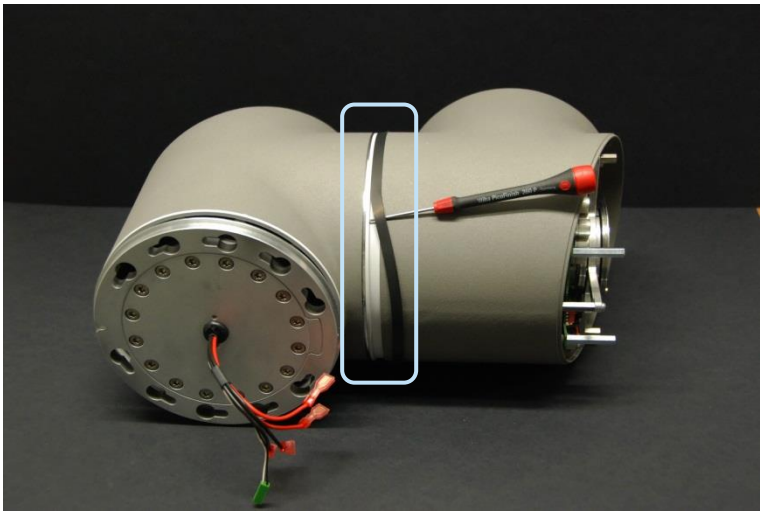
  2 x red wire = 48V DC

  2 x black wire = GND

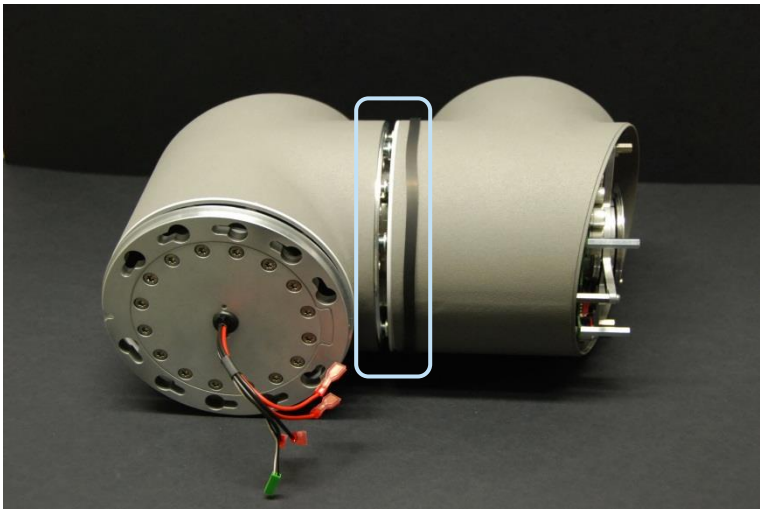
  Green connector = bus cable



- Gently remove black flexible flat ring between Wrist 2 and Wrist 3 with a tiny screwdriver or similar tool and twist it around the joint housing.

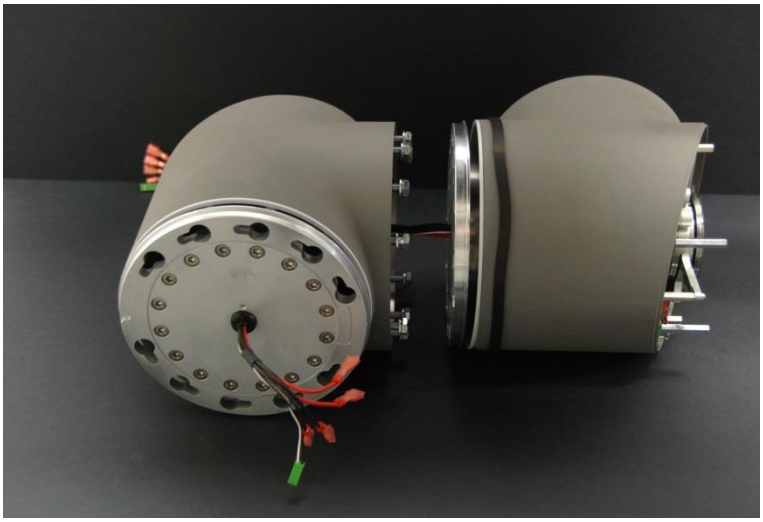


- Slide the grey Teflon ring apart.
  10 screws become visible, 5 on each side of joint.
  Untighten gently the screws with a 5.5 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.



- Pull Wrist 2 joint and Wrist 3 joint apart and gently twist the two parts in opposite directions around 8 mm. until a mechanical stop is met (holes are keyhole-type).

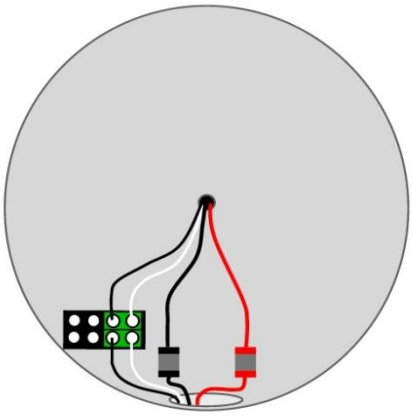
- Pull away Wrist 2 joint from Wrist 3 joint.



➢ Wrist 2 joint and Wrist 3 joint has now been separated.

- For separating Wrist 3 joint from tool flange, consult chapter 3.1.9 Replacement of tool flange.

- Replace Wrist 3 and gently insert Wrist 2 joint with screws and washers into Wrist 3 joint.
- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting the Wrist 2 joint and Wrist 3 joint in opposite directions until a mechanical stop is met.
- Tighten the 10 screws lightly, then tighten in cross order with 1.3Nm.
- Slide the grey Teflon ring in place and gently put back the flat ring on top of the Teflon ring.
- Mount the grease plug and tighten with 0.8Nm.
- Reconnect connectors as illustrated into Wrist 3.



- Mount blue lid on Wrist 3 joint and tighten with 0.5Nm.

➢ Wrist 2 joint and Wrist 3 joint has now been assembled.

- For assembling Wrist 3 joint and tool flange, consult chapter 3.1.9 Replacement of tool flange.

- Proceed to chapter 3.1.11 Joint calibration for calibrating the joint.

3.1.9 Replacement of tool flange

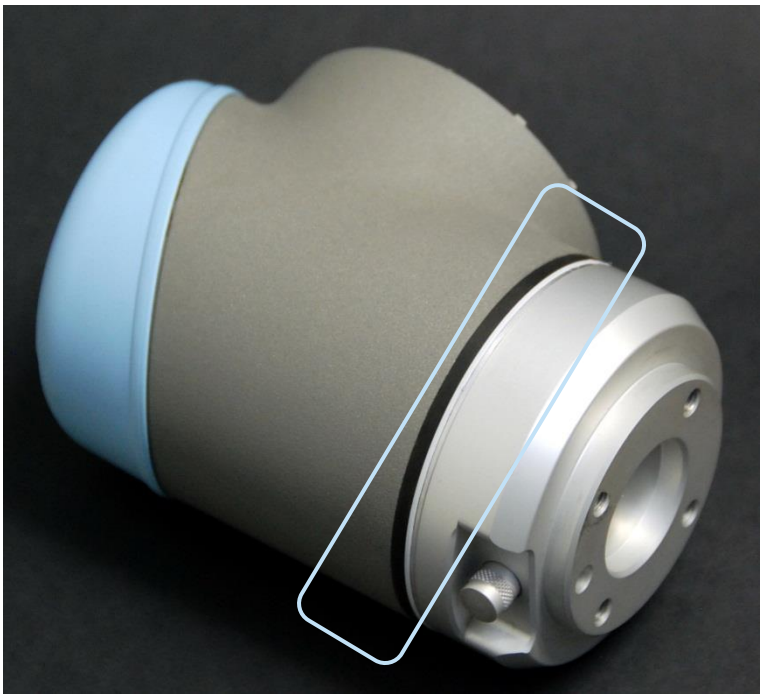
How to replace tool flange

- Move robot to a comfortable position for replacing the tool flange. If necessary dismount entire robot arm from work cell and place arm on solid surface.

- Shut down the controller.

- Remove grease plug.

- Gently remove black flexible flat ring with a tiny screwdriver or similar tool and twist it around the joint housing.



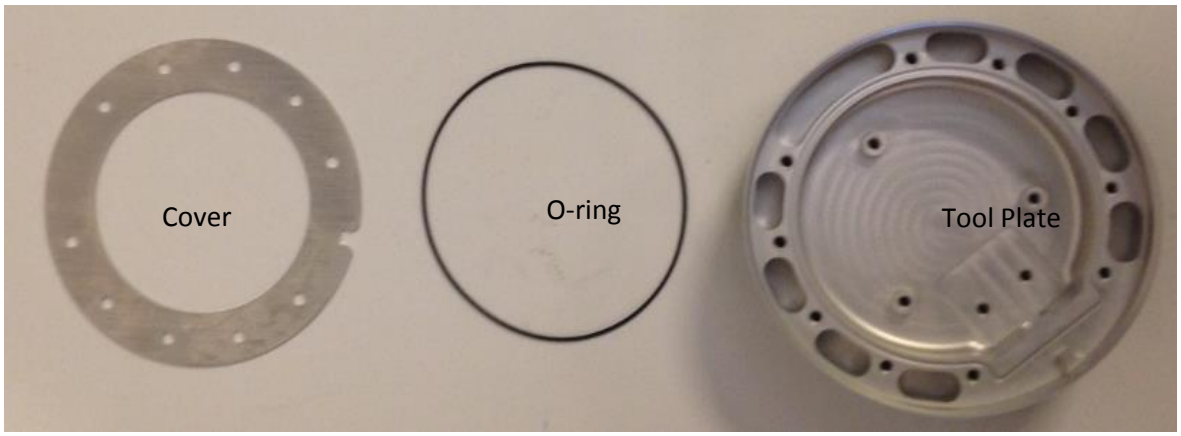
- Slide the grey Teflon ring apart.
  10 screws become visible, 5 on each side of joint.
  Untighten gently the screws with a 5.5 mm. open-ended spanner about two full rounds, approximately 3 mm. for each screw.

- Pull the tool flange and Wrist 3 joint apart and gently twist the two parts in opposite directions around 8 mm. until a mechanical stop is met (holes are keyhole-type).

- Pull away the tool from Wrist 3 joint.

- Disconnect the two connectors.

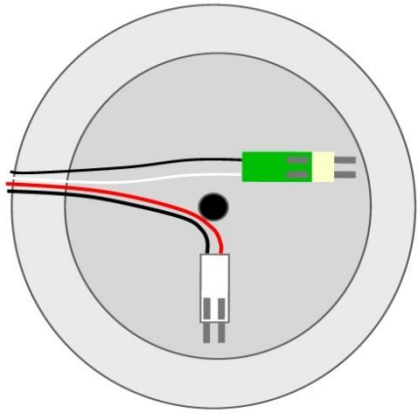
- Assembly of replacement tool flange.



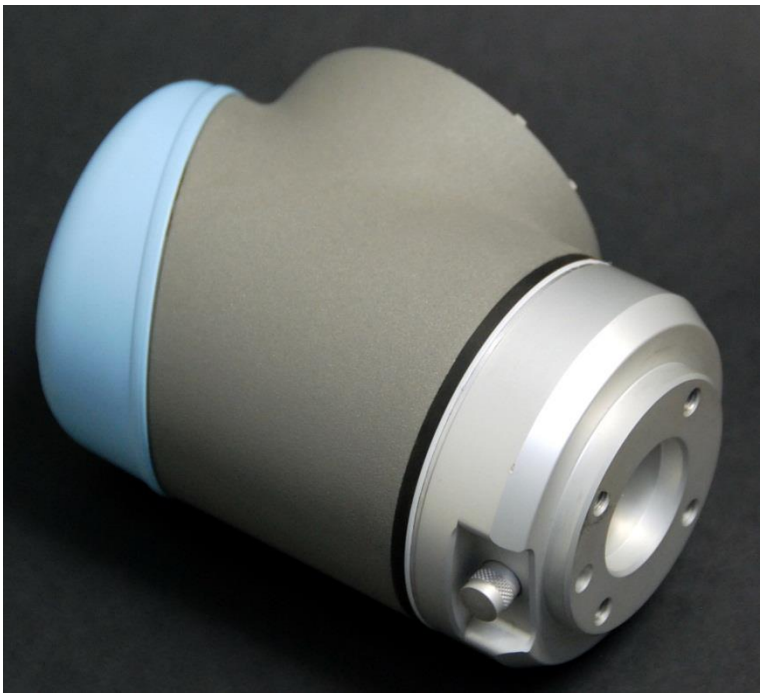
- Insert carefully O-ring into the Tool Plate and place cover on top

- Final assembly of replacement tool flange.

- Replace tool flange and reconnect connectors as illustrated.



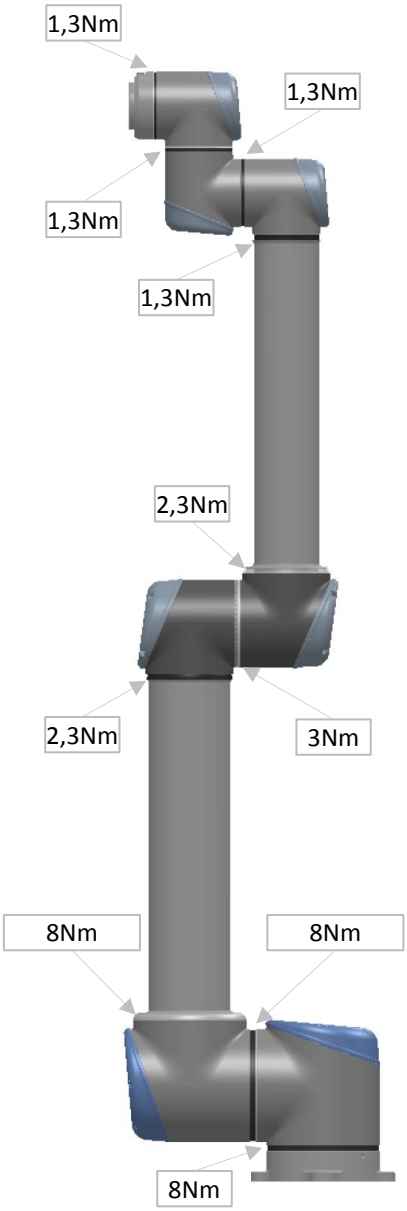
- Replace base plate and reconnect wires correctly.
- Gently insert tool flange with screws and washers into the Wrist 3 joint.
- Make sure the washers are fully inserted and located on the correct side (this is important) before gently twisting the tool flange and Wrist 3 joint in opposite directions until a mechanical stop is met.
- Tighten the 10 screws lightly, then tighten in cross order with 1.3Nm.
- Slide the grey Teflon ring in place and gently put back the flat ring on top of the Teflon ring.



- Mount the grease plug and tighten with 0.8Nm.

3.1.10 Torque values

UR10 torque values			
CONNECTION		TORQUE	HEAD SIZE
BASE PLATE	J0 BASE	8Nm	10 mm.
[J0] BASE	J[1] Shoulder	8Nm	10 mm.
[J1] SHOULDER	LOWER ARM	8Nm	10 mm.
LOWER ARM	[J2] ELBOW	2,3Nm	7 mm.
[J2] ELBOW	DUMMY JOINT	3Nm	7 mm.
DUMMY JOINT	HIGHER ARM	2,3Nm	7 mm.
HIGHER ARM	[J3] WRIST 1	1,3Nm	5,5 mm.
[J3] WRIST 1	[J4] WRIST 2	1,3Nm	5,5 mm.
[J4] WRIST 2	[J5] WRIST 3	1,3Nm	5,5 mm.
[J5] WRIST 3	TOOL	1,3Nm	5,5 mm.



3.1.11 Joint calibration

After replacement of joint it is required to calibrate the new joint in order to find the correct zero position of joint.

Instruction for calibrating a joint

- Jog robot to HOME position

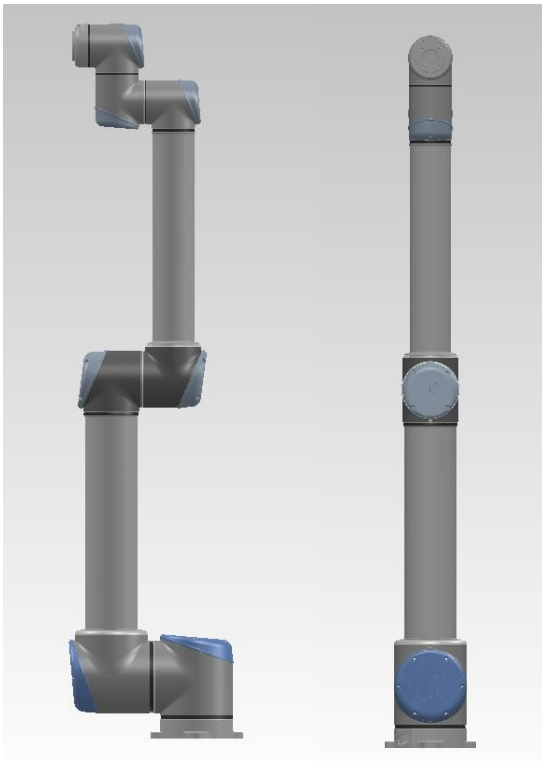
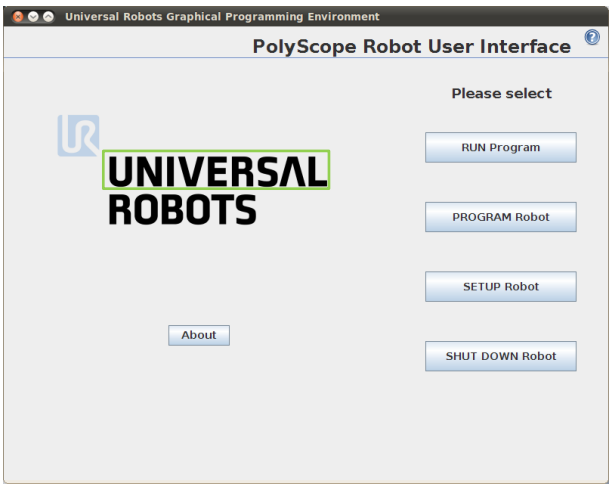
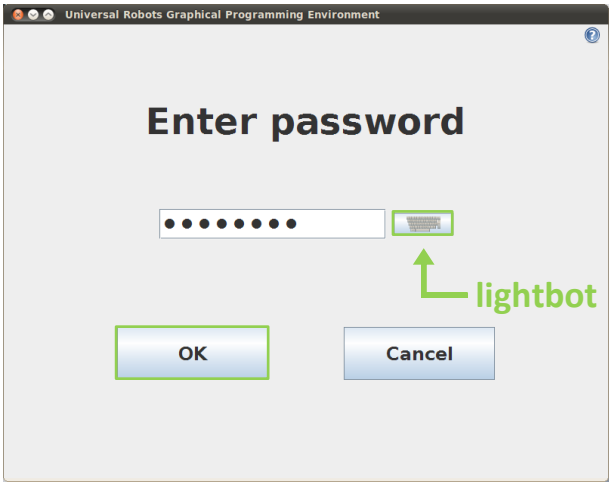


Illustration shows the HOME position, which is defined as zero position of all joints.

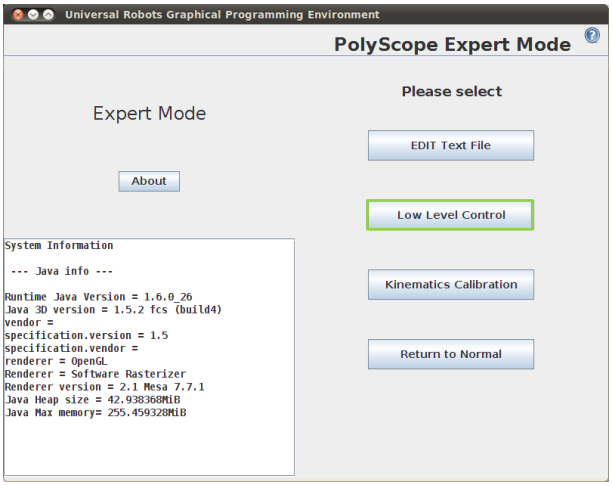
- Drag a finger from left to right across the *UNIVERSAL*-sign on main screen of PolyScope.



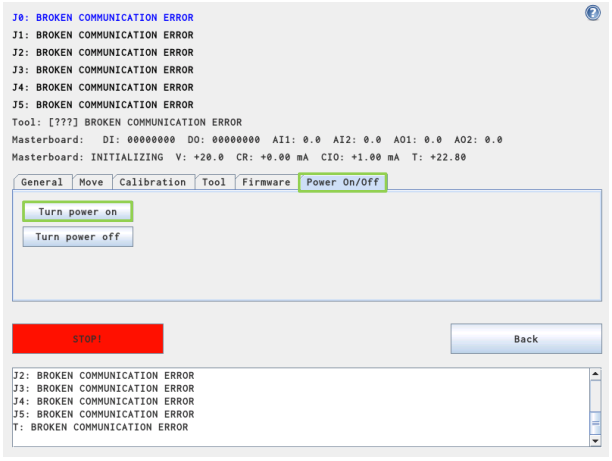
- Enter password *lightbot* and press *OK*.



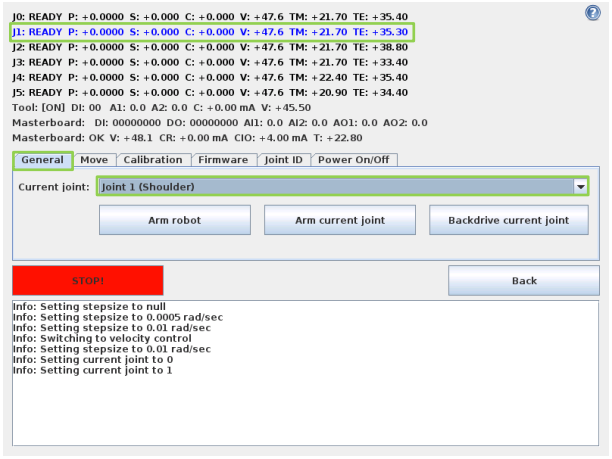
- You are now in *Expert Mode*, press *Low Level Control*.



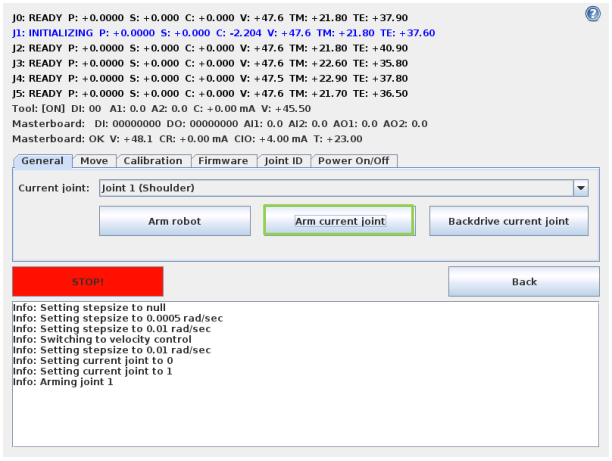
- Select *Power On/Off* tab and press *Turn power on* for enabling power to motors.



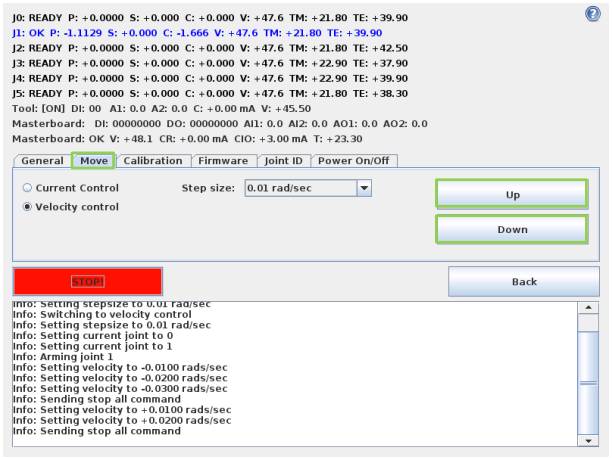
- Select *General* tab, and select the desired joint by either using the dropdown list or directly press on the joint state line.



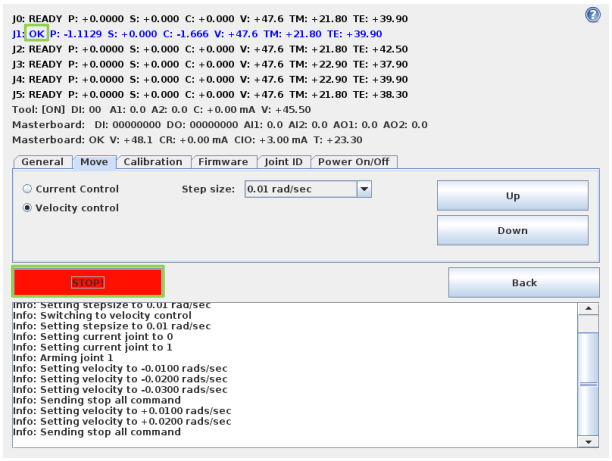
- Press *Arm current joint* for releasing the brake on the selected joint.



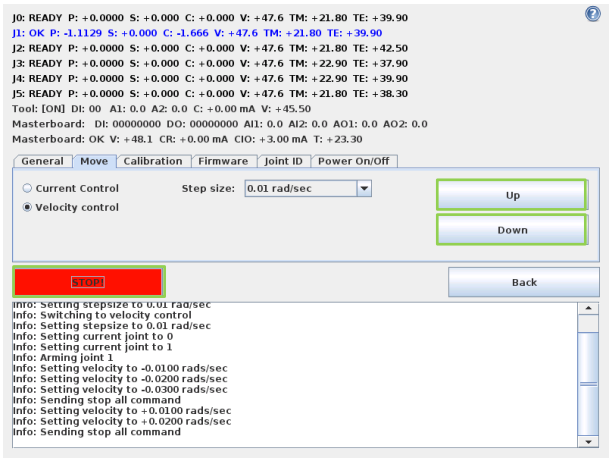
- Select *Move* tab and press either *Up* or *Down* for the joint to find its index mark. For every time the button is pressed, the velocity of joint will be increased.



- Await that state of the joint changes to *OK*, then press *STOP*.
  Index mark has now been found (index mark is not the same position as zero position).

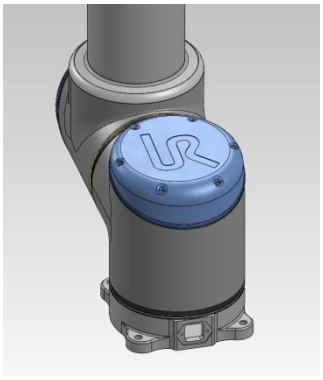


- Use the *Up* and *Down* buttons for navigating the joint to the correct zero position according to the following illustrations.
  Press *STOP* when the joint is in the correct position.



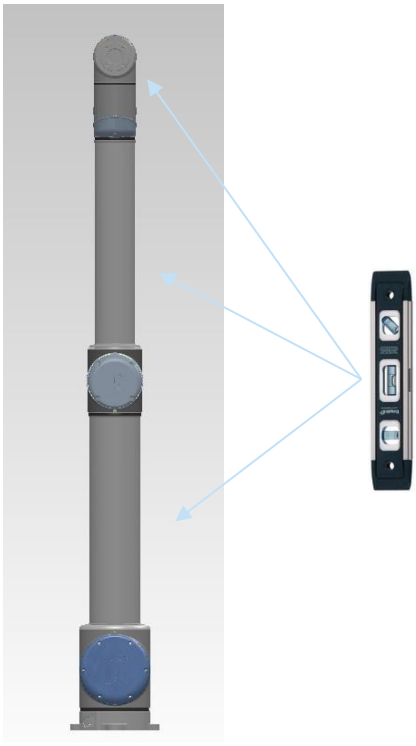
- Zero position illustrations

Base:



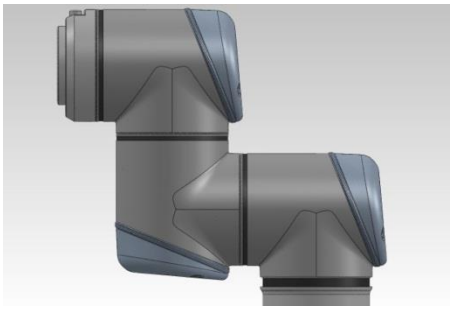
Base zero position is aligned to connector in back of robot base.

Shoulder, Elbow, Wrist 1:



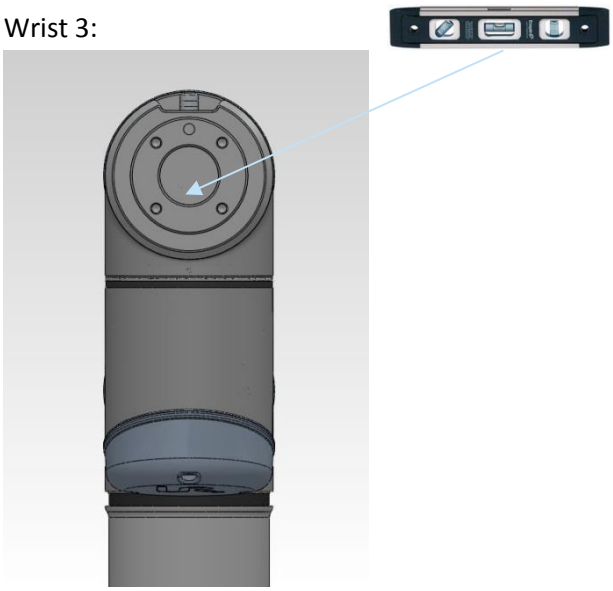
Shoulder, Elbow and Wrist 1 zero positions are Vertical aligned (if Base if horizontal).
Make sure that base of robot is positioned horizontal, use leveler for aligning joints.

Wrist 2:



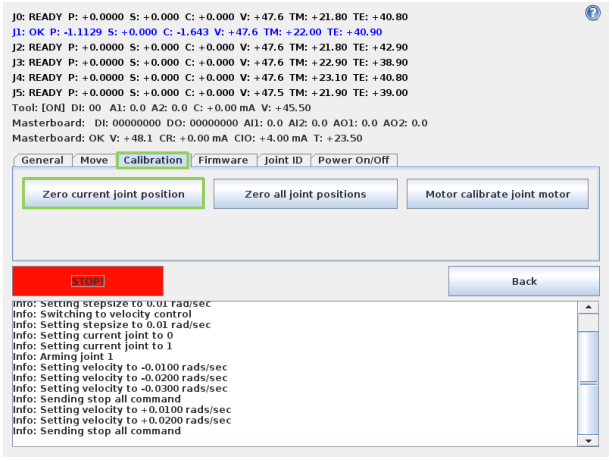
Wrist 2 zero position is aligned similar to Base joint.

Wrist 3:

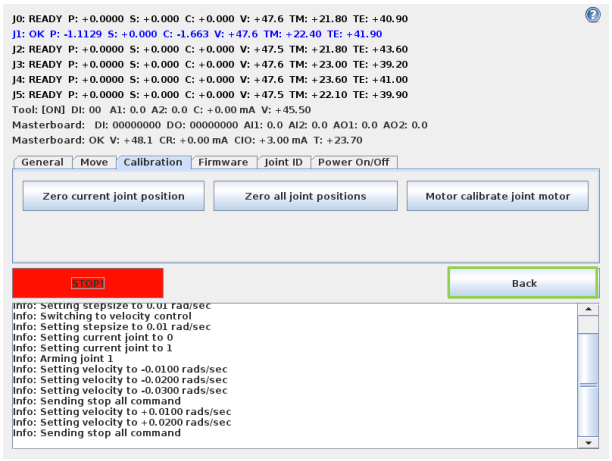


Wrist 3 zero position is aligned so tool connector is pointing upward.
Mount two bolts in tool holes and use leveler for aligning joint.

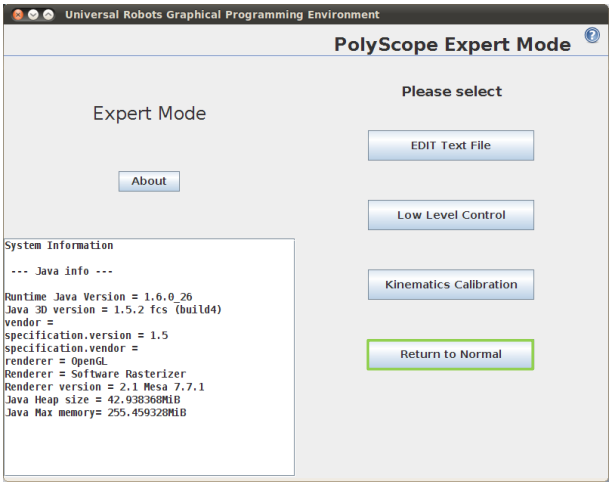
- Select *Calibration* tab and press *Zero current joint position* for calibrating the joint.



- Press *Back* for exiting Low Level Control.



- Back in Expert Mode, press *Return to Normal*.



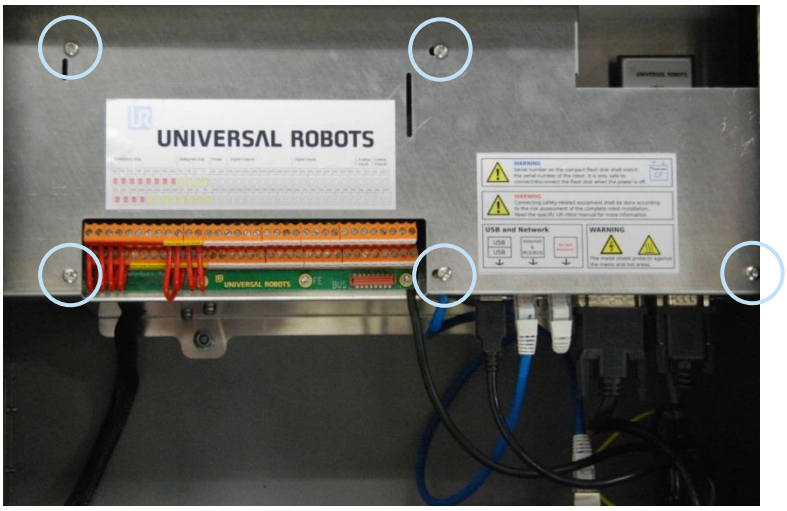
- Verify zero position by moving the robot to HOME.
  If not satisfied with the zero position, perform the procedure once again.

3.2 Controller

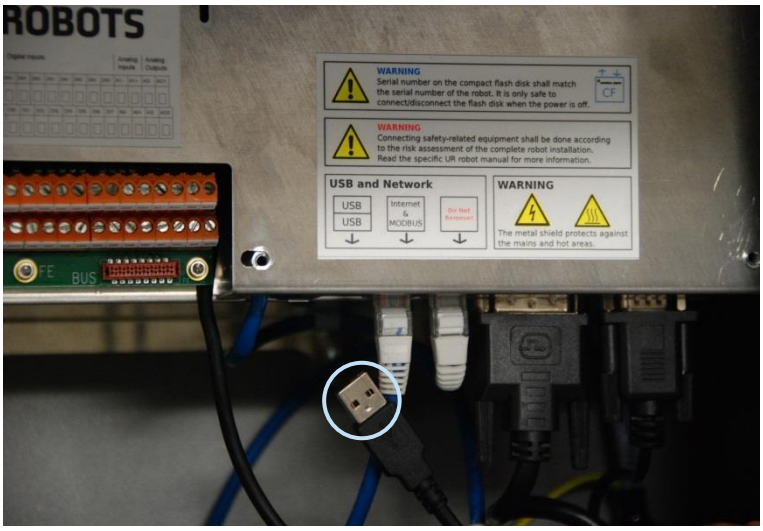
3.2.1 Replacement of teach pendant

How to replace Teach Pendant on Controller

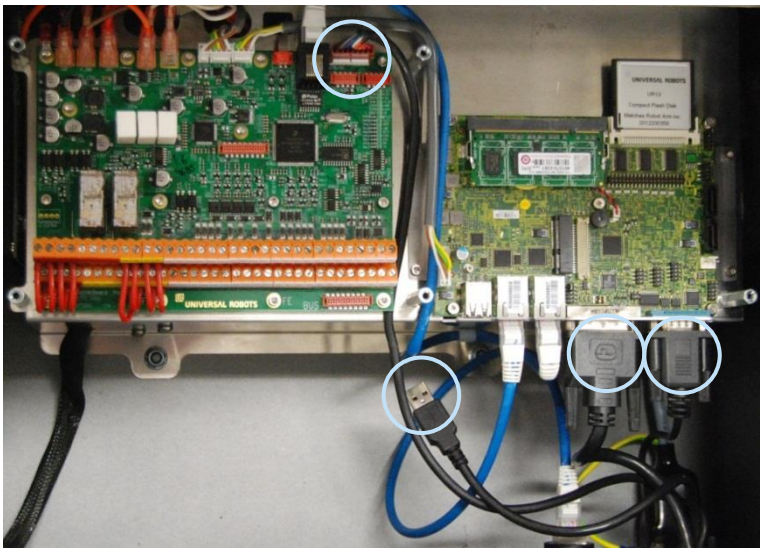
- Shut down the controller and disconnect the power cable, open the controller cabinet and loosen the 5 Torx screws and remove the alu cover plate**.**



- Remove black USB plug from motherboard and push the alu cover to the right and pull out alu cover for removal.



- Disconnect 4 cables:
  Red plug with black cable
  Black USB cable
  Black DVI cable
  Black cable for RS232-connection to touchscreen



- Remove the bracket (foot of the controller box) that holds the cable inlet and pull out the cables and plugs through this hole.

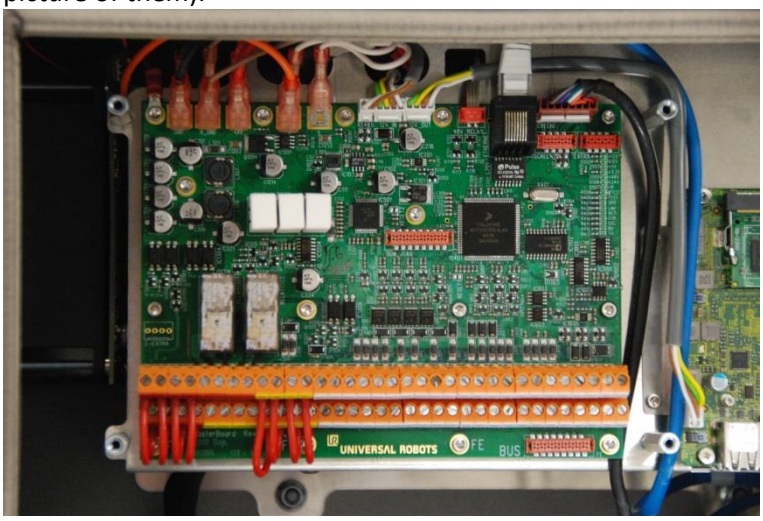
- Replace teach pendant with new, insert cable in cable inlet and perform reconnection of all plugs and mounting of alu cover in reversed order of the above description.
- Connect power and verify that teach pendant works properly.

3.2.2 Replacement of Masterboard

How to replace Masterboard in Controller box

Note: use the same procedure for power down and removing the alu cover plate as in chapter 3.2.1 Replacement of teach pendant

- Carefully remove all plugs and connectors (it is recommended to mark the cable positions or take a picture of them).



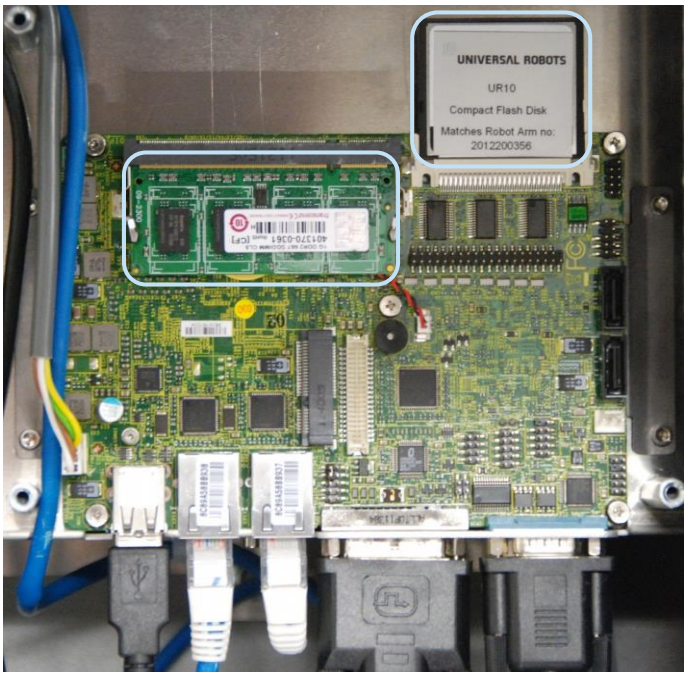
- Remove 15 screws holding the Masterboard.
- Replace Masterboard with new and tighten the 15 screws to hold the board
- Insert all connectors and plugs in correct positions.
- Carefully put back the grey alu cover plate, make sure to mount it correct and fix it with the 5 screws.
- Connect power and verify that teach pendant works properly.

3.2.3 Replacement of motherboard

How to replace motherboard in Controller box

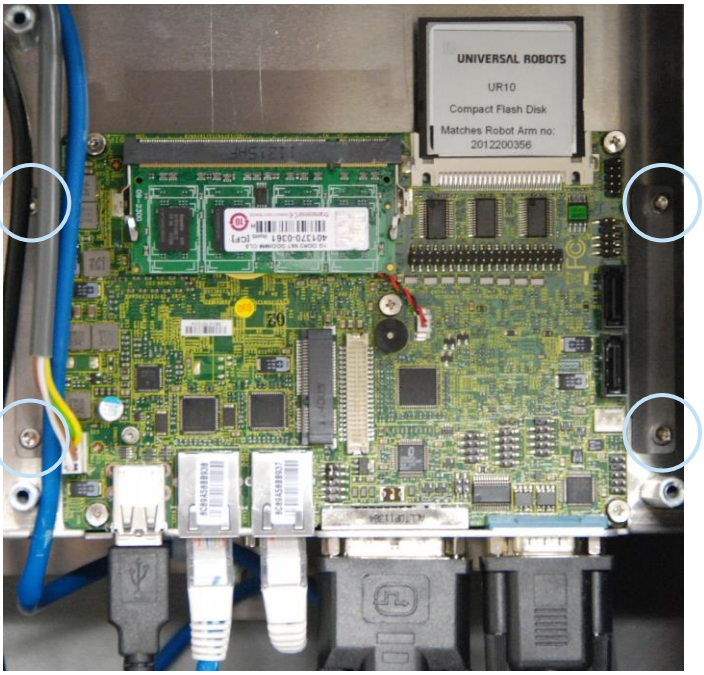
Note: use the same procedure for power down and removing the alu cover plate as in chapter 3.2.1 Replacement of teach pendant

- Remove Flash card and RAM block.



- Disconnect cable connections from motherboard:
  2x RJ45 network cables
  Black USB cable
  DVI-cable
  Black cable for RS232-connection
  White plug with white, brown, yellow and green wires

- Remove the 4 screws of the 2 holding brackets.



- Replace Motherboard with new.
- If controller is equipped with long-hole brackets, make sure to replace them with circular-hole brackets. Tighten the 4 screws gently.
- Insert the 6 cables in correct positions.
- Re-install Flash card and RAM block.
- Carefully put back the grey alu cover plate, make sure to mount it correct and fix it with the 5 screws.
- Connect power and verify that teach pendant works properly.

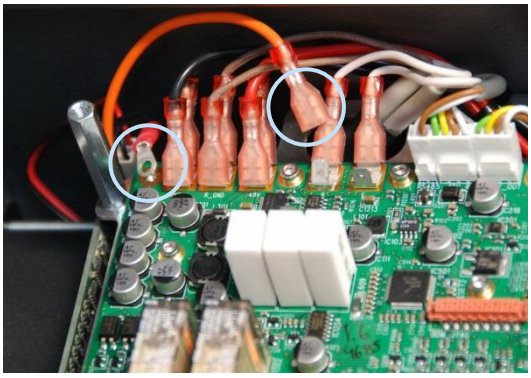
3.2.4 Replacement of 48V power supply

How to replace 48V power supply in Controller box

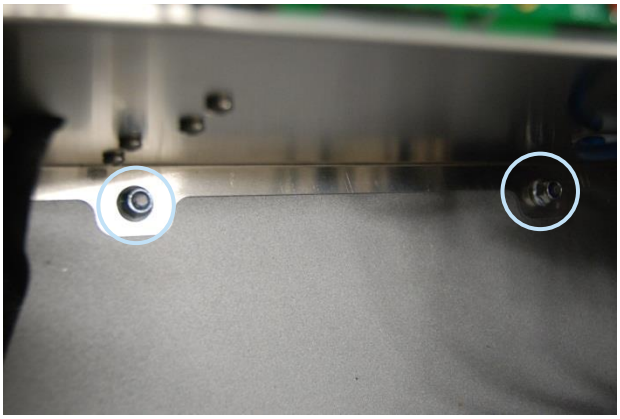
Note: use the same procedure for power down and removing the alu cover plate and cables for teach pendant as in chapter 3.2.1 Replacement of teach pendant

- Remove the handle on Controller box by loosen the 2 screws holding it.

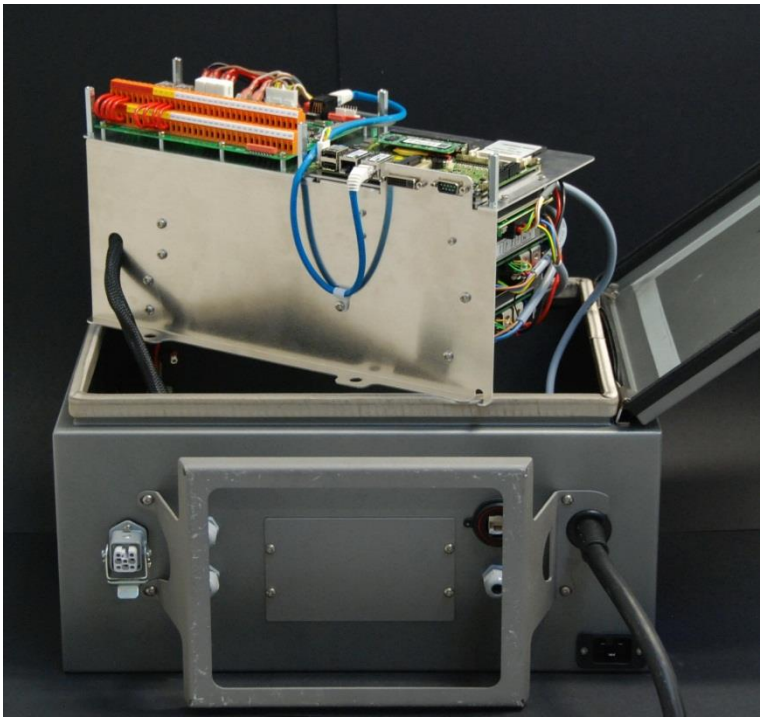
- Removes the 2 wires for the fan.



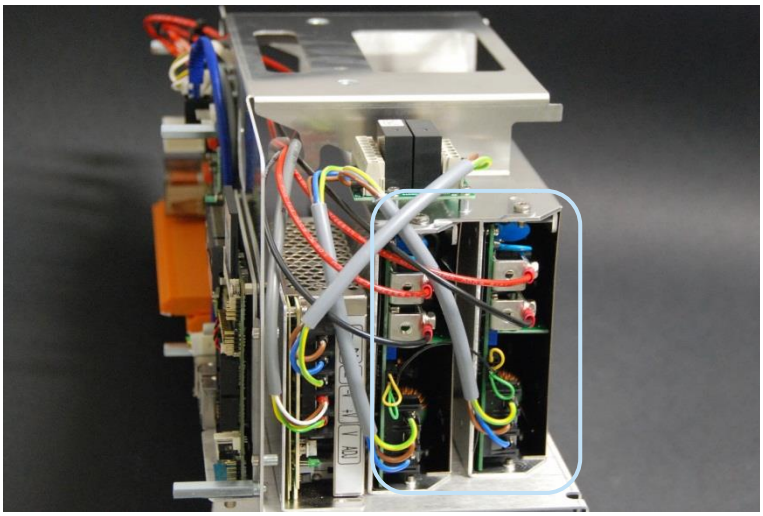
- Remove the 2 nuts in the bottom of Controller module.



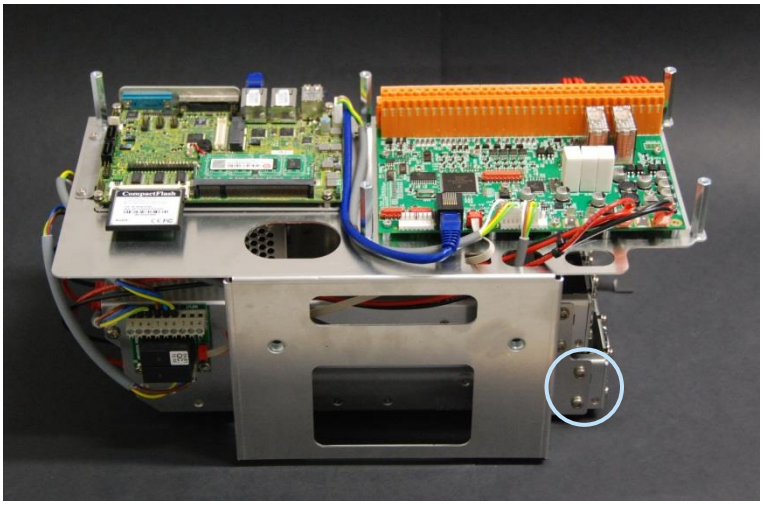
- Gently take out the controller module from the Controller box without disconnecting the robot cable and power cable.

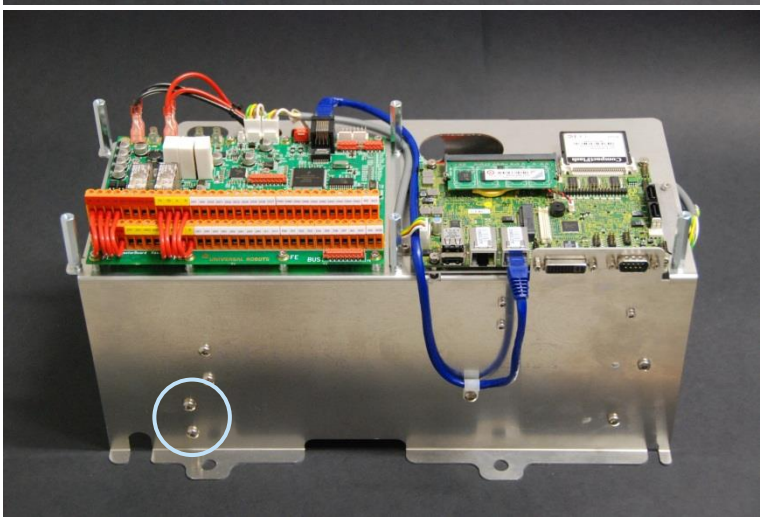


- Power supplies are located in the rack under the controller module, the two 48V power supplies are the lower ones in the rack.
  Before dismounting the 48V power supply, mark and disconnect the cables from that supply.



- Remove the screws respectively of the defective 48V power supply from the side of the rack.





- Replace 48V power supply with new.
- Reconnect the wires for the 48V power supply.
- Re-install Controller module in reverse order and connect the 2 wires for the fan and cables for the teach pendant.
- Carefully put back the grey alu cover plate, make sure to mount it correct and fix it with the 5 screws.
- Connect power and verify that teach pendant works properly.

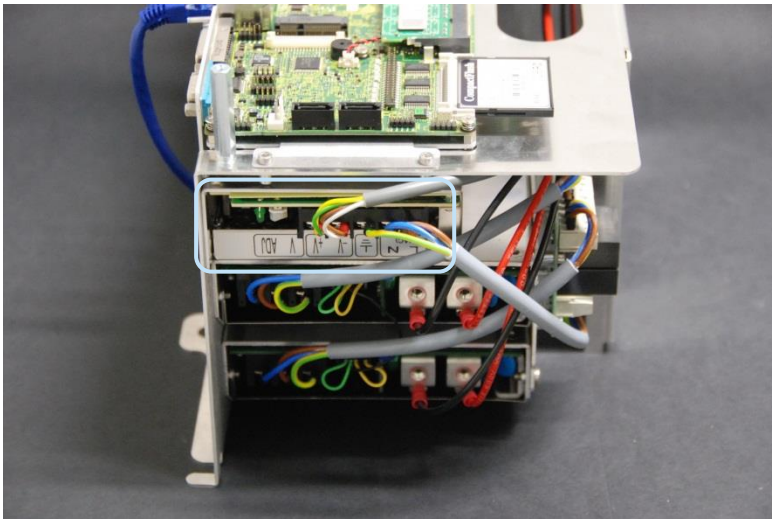
3.2.5 Replacement of 12V power supply

How to replace 12V power supply in Controller box

Note: use the same procedure for power down and removing the alu cover plate and cables for teach pendant as in chapter 3.2.1 Replacement of teach pendant

For replacing the 12V power supply follow exactly the same steps as for the procedure in chapter 3.2.4 Replacement of 48V power supply

- The 12V power supply is placed in top of rack. The screws holding it in the frame are placed on the sides.



- Replace 12V power supply with new.
- Reconnect the wires for the 12V power supply.
- Re-install Controller module in reverse order and connect the 2 wires for the fan and cables for the teach pendant.
- Carefully put back the grey alu cover plate, make sure to mount it correct and fix it with the 5 screws.
- Connect power and verify that teach pendant works properly.

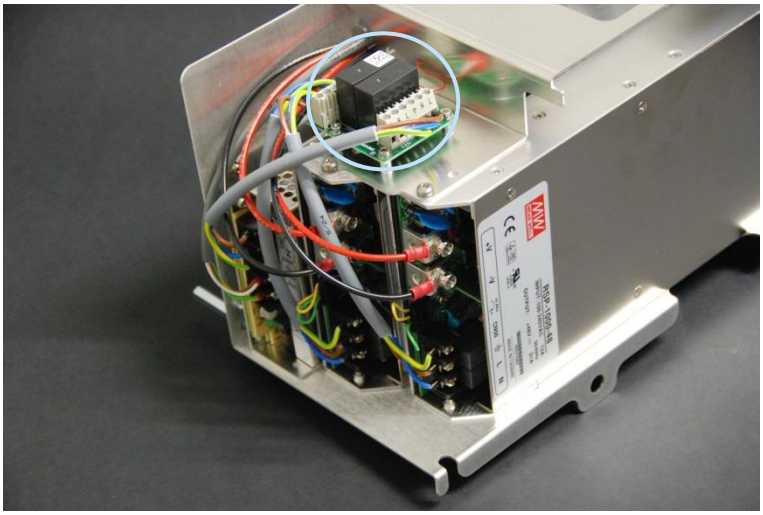
3.2.6 Replacement of current distributor

How to replace current distributor in Controller box

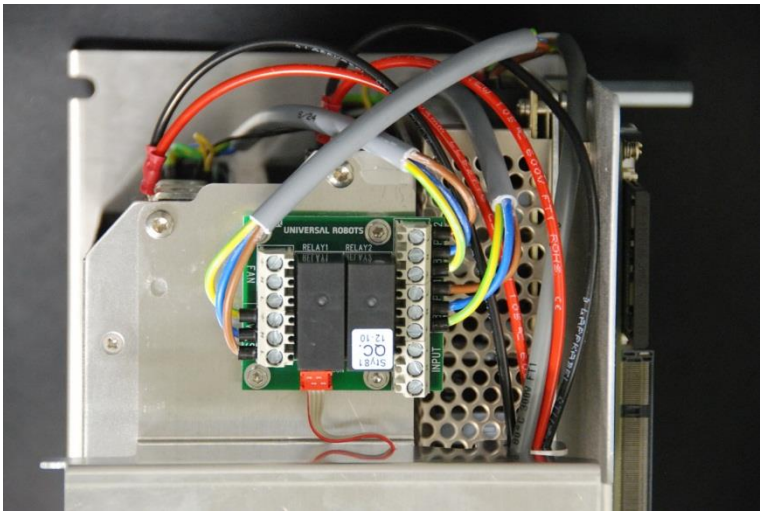
Note: use the same procedure for power down and removing the alu cover plate and cables for teach pendant as in chapter 3.2.1 Replacement of teach pendant

For replacing the current distributor follow exactly the same steps as for the procedure in chapter 3.2.4 Replacement of 48V power supply

- Current distributor is placed on top of rack.



- Before dismounting the current distributor, mark and disconnect the cables from the circuit board.



- Replace current distributor with new.
- Reconnect the wires for the current distributor.
- Re-install Controller module in reverse order and connect the 2 wires for the fan and cables for the teach pendant.
- Carefully put back the grey alu cover plate, make sure to mount it correct and fix it with the 5 screws.
- Connect power and verify that teach pendant works properly.

4. Software

4.1 Update software

Universal Robots software is named PolyScope.
This software can be updated, when new releases of software become available.

When updating software on robot with older version, it is required to install each update in sequence, i.e. if robot using software v1.5 must be updated to v1.7, it is required to first update to v1.6 and then update to v1.7.

If it ain't broken, don't fix it:
If a robot is operating in an existing application, Universal Robots do not recommend updating software, unless the use of new functions in a newer software release is required for this application.

IMPORTANT NOTICE:

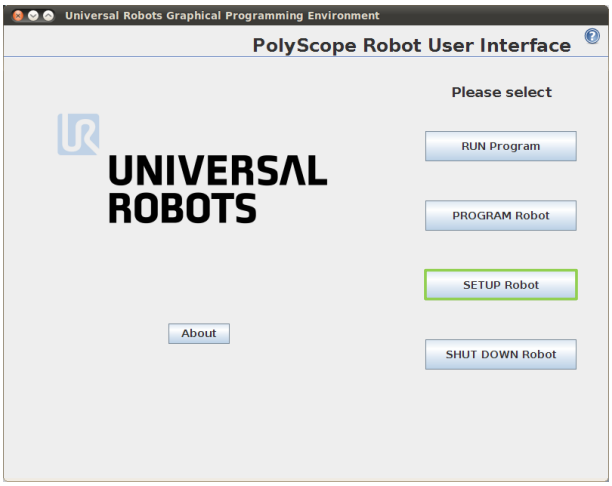
- Software should *only* be updated after consulting Distributor from where the robot has been purchased or if representing a Distributor after consulting Universal Robots.
- Universal Robots do *not* recommend updating software without proper instruction in how to update software.
- When updating firmware it is strictly forbidden to turn off controller during update.
- Universal Robots can be no means be held responsible for any failed update caused by improper operation.

Go to www.support.universal-robots.com/download for downloading software updates.
Login is required, only applicable for Distributors.

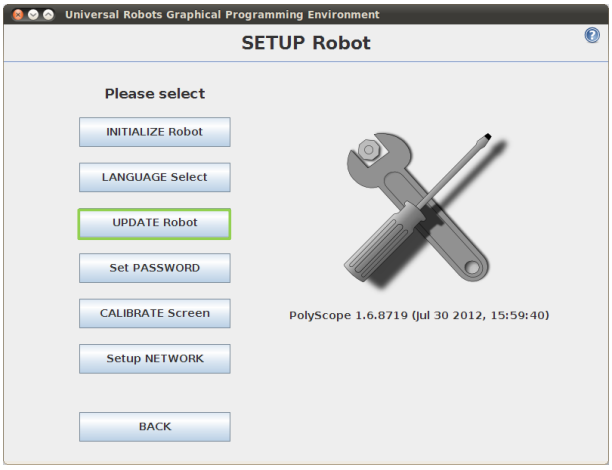
Please note: If representing an end customer, contact the Distributor from where the robot has been purchased for requesting software updates.

Instruction for updating software

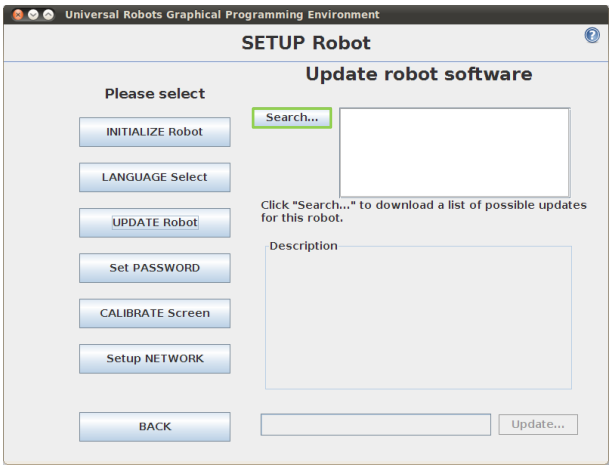
- Download software update. Carefully read requirements on support site relating to which software must be installed on robot prior to updating to the downloaded version.
- Save it in the root folder on a USB-stick.
- Insert USB-stick into USB-connector on right-hand side of teach pendant.
- Go to main screen of PolyScope.



- Press button *SETUP Robot*.
- In left side menu, select *UPDATE Robot*.



- Press button *Search* for searching after software update on USB-stick.



- Mark the found software update and press *UPDATE*.
- Press YES for updating the software.
- Await robot update software, after successful update controller will automatically shut power off.
- Remove USB-stick and boot robot.

4.2 Update joint firmware

Each joint on robot arm is provided with firmware for controlling the joint.

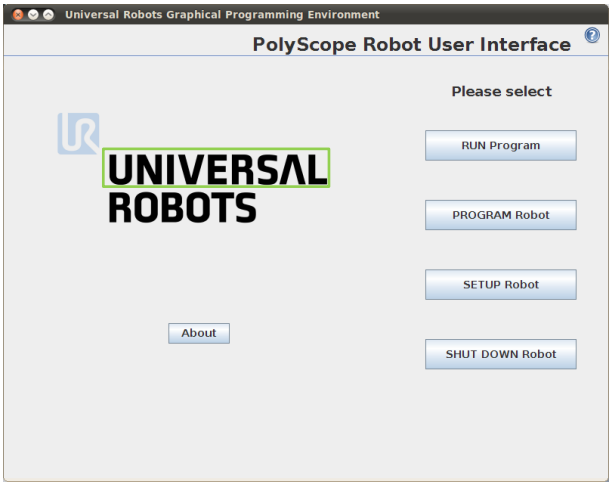
For normal operation firmware update is not required. Software can be updated on robot without updating the firmware.

IMPORTANT NOTICE:

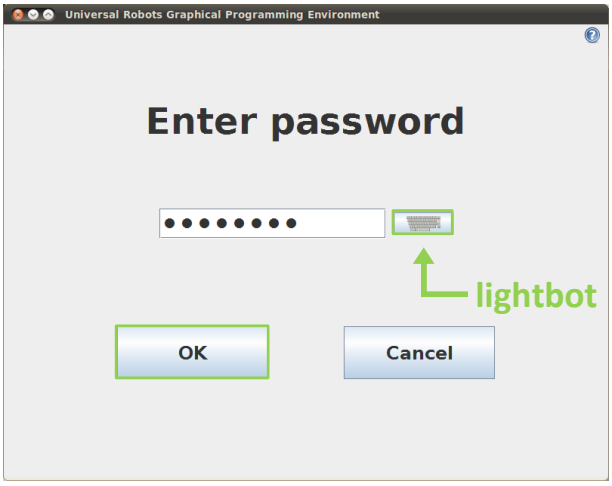
- Firmware should *only* be updated after consulting Distributor from where the robot has been purchased or if representing a Distributor after consulting Universal Robots.
- Universal Robots do *not* recommend updating firmware without proper instruction in how to update firmware.
- When updating firmware it is strictly forbidden to turn off controller or to remove cable between controller and robot arm during update.
- Universal Robots can be no means be held responsible for any failed update caused by improper operation.

Instruction for updating firmware
Prior to updating firmware, it is required to update the robot software.
Please refer to chapter 4.2 for updating software. When updating robot software, the firmware will automatically be copied to a folder on the controller.

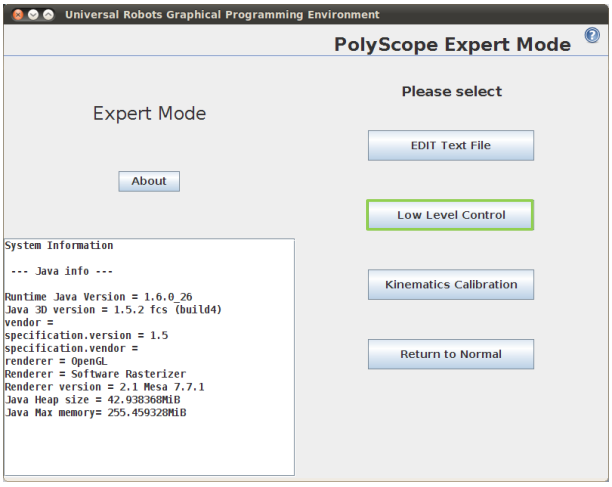
- Drag a finger from left to right across the *UNIVERSAL*-sign on main screen of PolyScope.



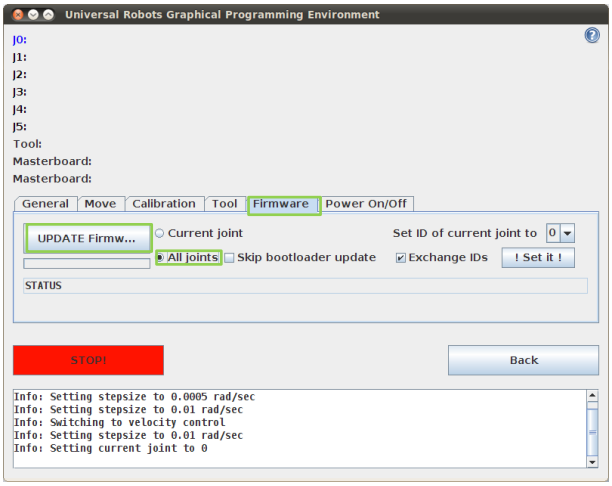
- Enter password *lightbot* and press *OK*.



- You are now in *Expert Mode*, press *Low Level Control*.

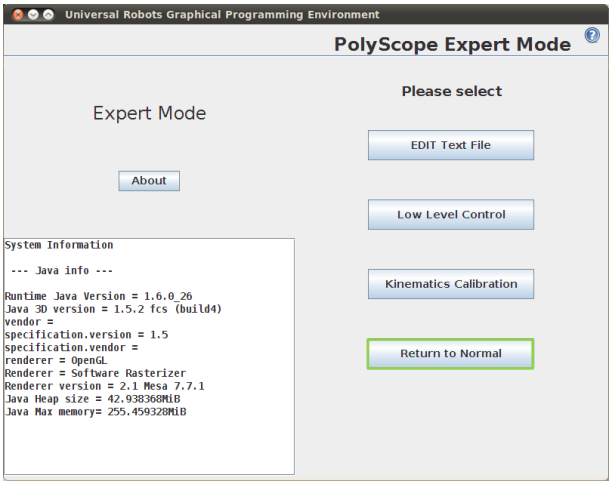


- Select the *Firmware* tab, mark All joints and press UPDATE firmware.



- Firmware update is being processed, await message that *robot firmware updated successfully*.
  It is strictly forbidden to turn off controller during this update.
- After successful update, press *Back*.

- Back in Expert Mode, press *Return to Normal*.



Firmware has now been updated.

4.3 Using Magic files

For easy backup, Universal Robots provides Magic files for automatic copy of data from controller to USB-stick.

These files are available:	Function:
• URmagic log file	copies the entire log history file to USB-stick
• URmagic backup programs	copies all programs and installation files to USB-stick
• URmagic configuration files	copies all configuration files to USB-stick
• URmagic upload programs	copies all programs and installation files *from* USB-stick
• URmagic screenshot	generates a screenshot of GUI when USB-stick is inserted

Go to www.support.universal-robots.com/download for downloading Magic files.
Login is required, only applicable for Distributors.

Please note: If representing an end customer, contact the Distributor from where the robot has been purchased for requiring Magic files.

Instruction for using Magic files

- Download Magic file.
- Save it in the root folder on a USB-stick.
- Insert USB-stick into USB-connector on right-hand side of teach pendant.
- After a few seconds a red **! USB !** -sign will appear on the screen, this is a warning not to remove the USB-stick, while the file will do its magic.
- Await a green **<- USB** -sign appears on the screen, then you can safely remove the USB-stick.
- Remove USB-stick and you're done.

The Magic file creates a folder on USB-stick named after the serial number of robot.

If more than one magic file is on USB-stick, they will be run in sequence, the warnings will then appear for each file. Do not remove the USB-stick before after the last file has been run. Multiple folders will be created and named after serial number added with a sequential no, like 201220xxx4_0, 201220xxx4_1 etc.

5. Troubleshooting

5.1 Error codes

Code	Error description	Issue concerning error	How to fix
4	Broken communication error	Serial communication problem with one or more joints	Check green 2-wire connectors and wires in joints
7	Joint encoder index interrupt drift error detected	Mechanical problem or firmware in joint	Update firmware or replace joint
11	Bad CRC error	Serial communication problem with joint	Check green 2-wire connectors and wires in joints
15	Master sniffed message addressed to invalid node ID	Serial communication problem with joint	Check green 2-wire connectors and wires in joints
17	In buffer overflow error in Master from PC	Communication error between Masterboard and Motherboard	Check ethernet connection between circuit boards
19	Master had no data to send to joints	Possible CPU-overload due to structure of user program	Restructure user program
25	Joint Encoder index drift detected	Problem with reading encoder position in joint	Adjust encoder with appropriate tool or replace joint
26	Motor Encoder index drift detected	Joint mechanical problem	Replace joint
29	Ethernet package loss detected from PC to robot	Possible CPU-overload due to structure of user program	Restructure user program
31	Caught wrong message (not from master)	Serial communication problem with joint	Check green 2-wire connectors and wires in joints
37	In buffer parse error	Serial communication problem with joint	Check green 2-wire connectors and wires in joints
40	AD-Converter hit high limit	EMC issue external or electronics internal	Check grounding and shielding for EMC problems
43	Could not track target position	External blocking, encoder, brake, gear, acceleration too high, payload too high	Use Teach Mode for checking manual jog with joint Open blue lid on joint and check brake pin, consult chapter 3.1.2 Reduce acceleration in user program Verify payload is correct Replace joint if necessary
44	CRC error, likely from joint	Serial communication problem with joint	Check green 2-wire connectors and wires in joints

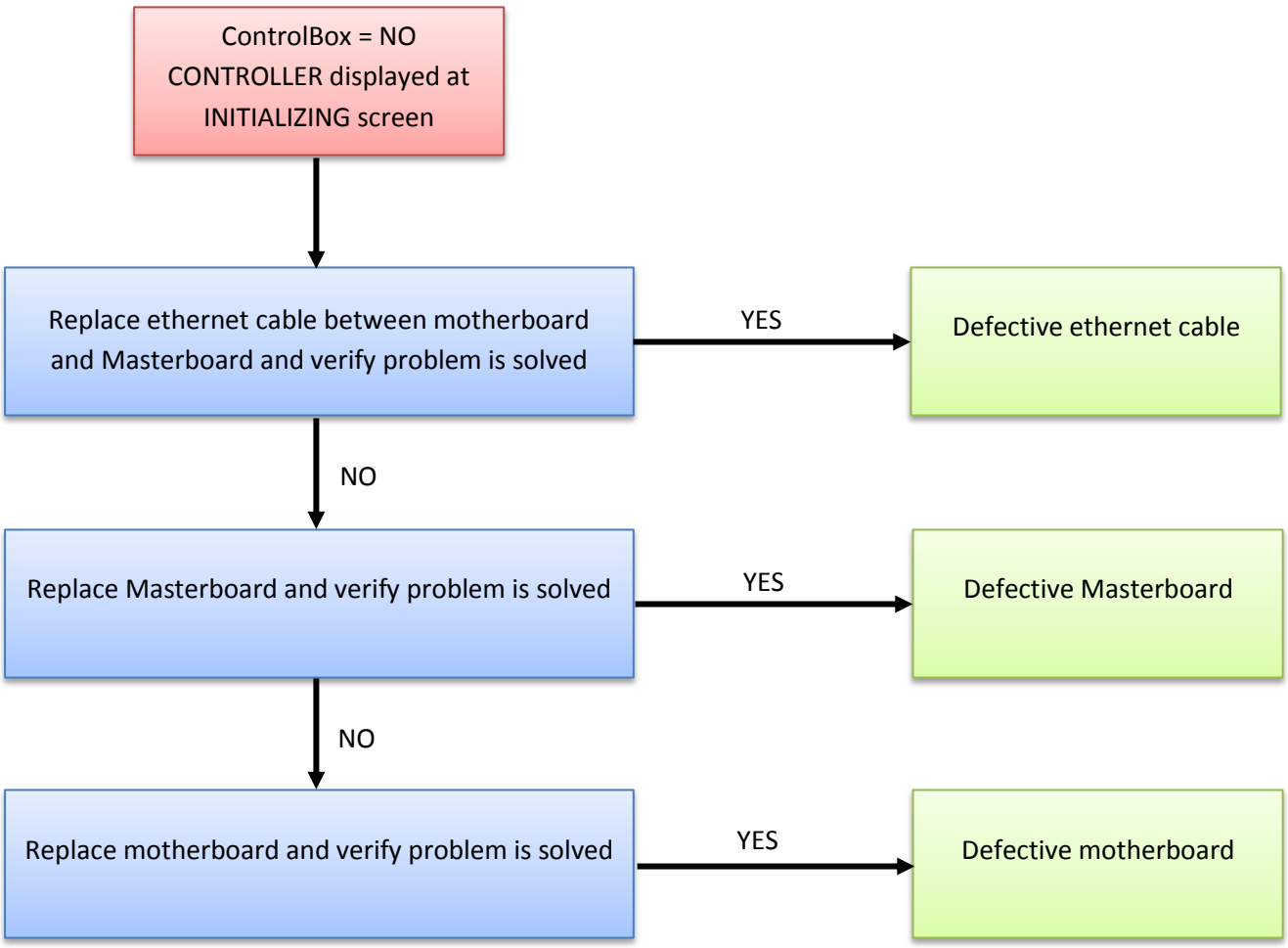
46	Loose gearbox or bad encoder mounting	Mechanical problem in gear related to encoder mounting	Replace joint
47	AD-Converter hit low limit	EMC issue external or electronics internal	Check grounding and shielding for EMC problems
48	Powerbus voltage drop detected	Error on 48V powerbus	Check 48V output from PSU Check Current Distributor pcb Replace 48V PSU or Curernt Distributor is necessary
50	Robot power up failure	Electrical error control box	Remove all external connections to I/O-interface of Masterboard Check for short circuit Argument of error code specifies in details what causes the error
51	Emergency relay failure	Masterboard error	Replace Masterboard
53	IO, Master or Tool overcurrent	Too high current consumption	Remove all external connections to I/O-interface of Masterboard Check for short circuit
55	Safety system error	Safety system malfunction	Check Motherboard, Masterboard, Screenboard, Current distributor (Euromap, if installed) Bypass safety connections to I/O-interface of Masterboard
56	Overvoltage shutdown	Voltage exceeded 55V	Check Energy Eaters Replace Energy Eater
57	Joint speed deviation	External blocking, encoder, brake, gear, acceleration too high, payload too high	Use Teach Mode for checking manual jog with joint Open blue lid on joint and check brake pin, consult chapter 3.1.2 Reduce acceleration in user program Verify payload is correct
59	Overcurrent shutdown	Overcurrent in joint	Check for short circuit Check program for singularity issues Replace joint if necessary
61	Missed joint index mark	Encoder too far off shaft	Adjust encoder with appropriate tool Replace joint if necessary
62	Thermal shutdown	Joint temperature exceeded 80 deg. C	Reduce acceleration in user program Check ambient temperature Replace joint if necessary
66	Version mismatch error	Masterboard version not matching config file info	Edit config file, contact distributor
70	Close to gearbox shear	Acceleration / deceleration to high	Reduce acceleration in user

	limit	Mechanical problem in gear related to encoder mounting	program Replace joint if necessary
100	Robot changed mode	Status warning, general modus change	Check preceding errors in log history
107	Joint has too many errors in a row	After 3 consecutive errors, result of preceding errors	Check preceding errors in log history Replace joint if necessary
109	Security Stop	Generated by controller safety system. Security limit exceeded	Check preceding errors in log history
110	Joint Security Stop	Generated by controller safety system Security limit exceeded	Check preceding errors in log history
113	Force limit protective stop	Robot movement blocked Collision or mechanical failure Acceleration too high in user program TCP and payload settings incorrect	Use Teach Mode for checking manual jog with joint Open blue lid on joint and check brake pin, consult chapter 3.1.2 Reduce acceleration in user program Verify payload is correct
114	High Measured Force Warning	Warning prior to error code 113: Force Limit Protective Stop	Use Teach Mode for checking manual jog with joint Reduce acceleration in user program Verify payload is correct
115	Wrong robot type	Can be related to different causes: Wrong setting in urcontrol.conf file Defective 48V PSU Defective Masterboard Defective Current Distributor pcb	Check settings in config file Replace 48V PSU, Masterboard or Current Distributor pcb if necessary
116	Real time part warning	Possible CPU-overload due to structure of user program	Restructure user program
150	SECURITY CHECK: Position change too large	Incorrect TCP and payload setting Too high acceleration, typically when running robot in positions with full reach and full payload	Verify TCP and payload settings Reduce acceleration in user program
151	SECURITY CHECK: Joint limit violation	Incorrect TCP and payload setting Too high acceleration, typically when running robot in positions with full reach and full payload	Verify TCP and payload settings Reduce acceleration in user program
153	SECURITY CHECK: Speed limit violation	Incorrect TCP and payload setting Too high velocity, typically in linear movements close to singularity	Verify TCP and payload settings Reduce speed or modify positions in user program
156	SECURITY CHECK: Torque limit violation	Incorrect TCP and payload setting Incorrect Mounting setting Too high acceleration	Verify TCP, payload and Mounting settings Reduce acceleration in user program
190	Modbus error	Incorrect setting of Modbus addr. or	Verify settings and

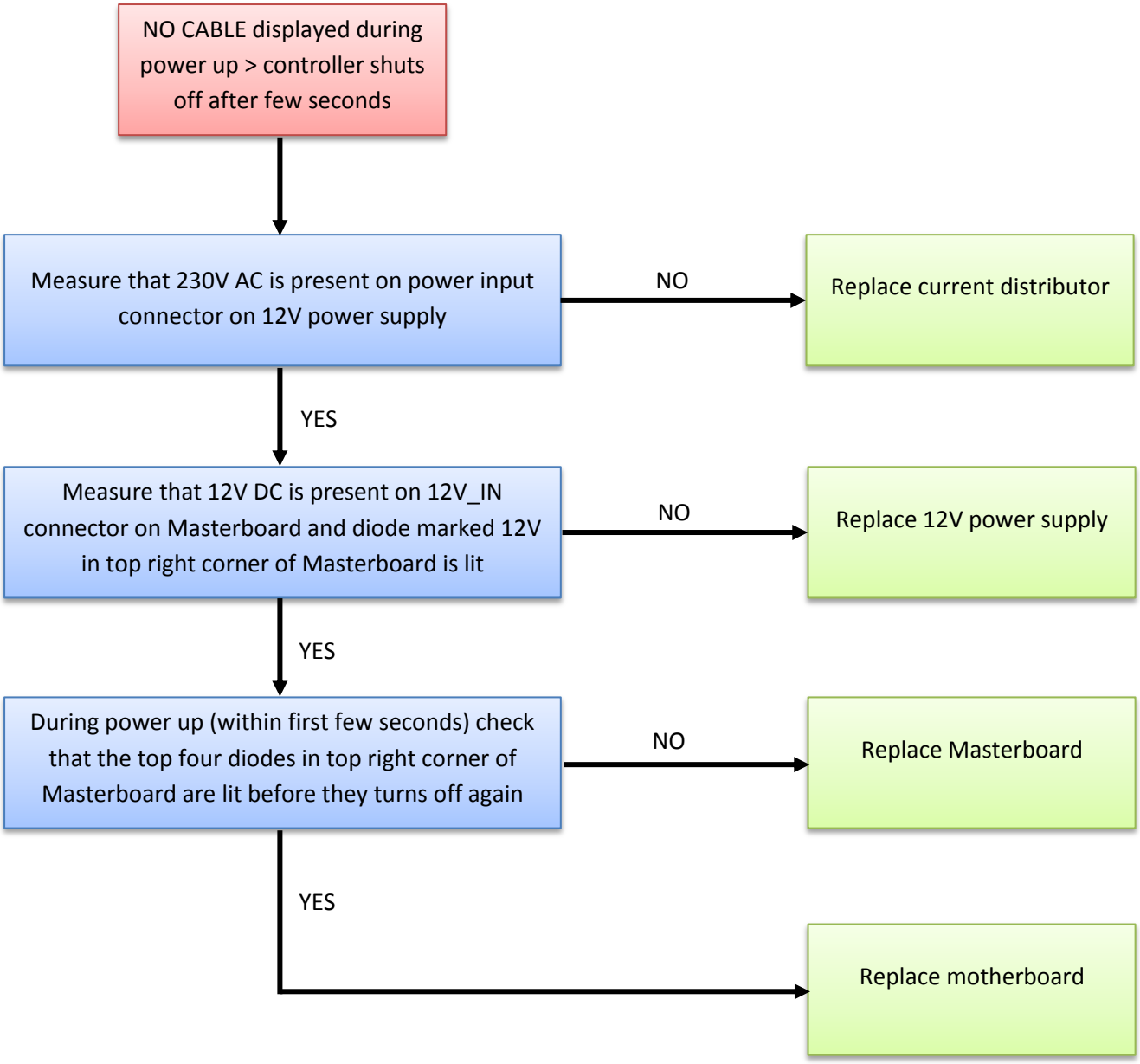
		comm. lost between robot and device	communication
191	Force mode error	Incorrect settign of Force Mode Robot TCP close to singularity	Verify settings
194	Conveyor speed too high	Conveyor speed higher than robot is able to run	Adjust conveyor tick count accordingly
195	MoveP speed too high	Too high speed in relation to blend radius	Reduce speed or increase blend radius in user program

5.2 Error phenomena

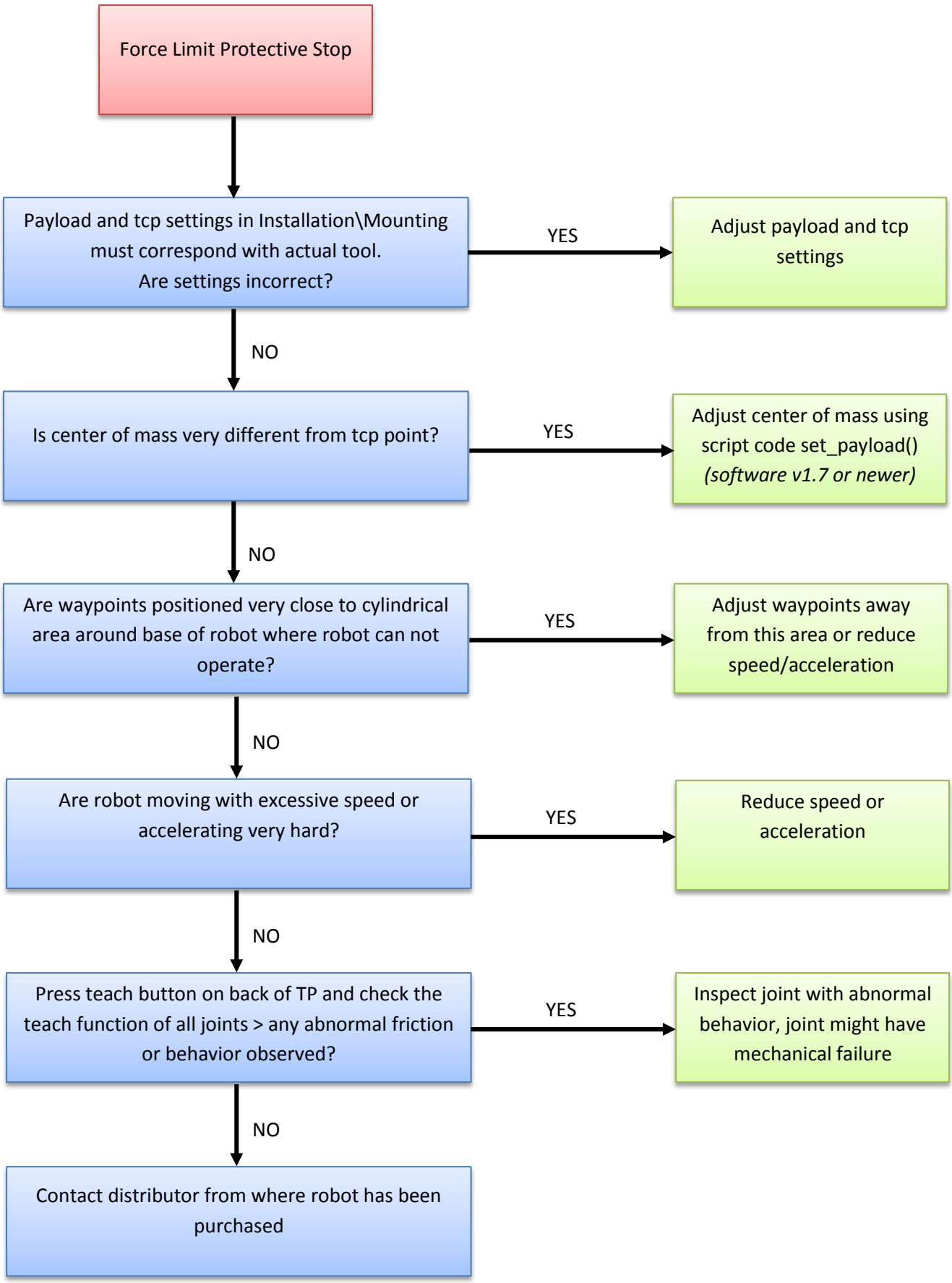
5.2.1 ControlBox: NO CONTROLLER displayed in Initializing



5.2.2 NO CABLE displayed during power up



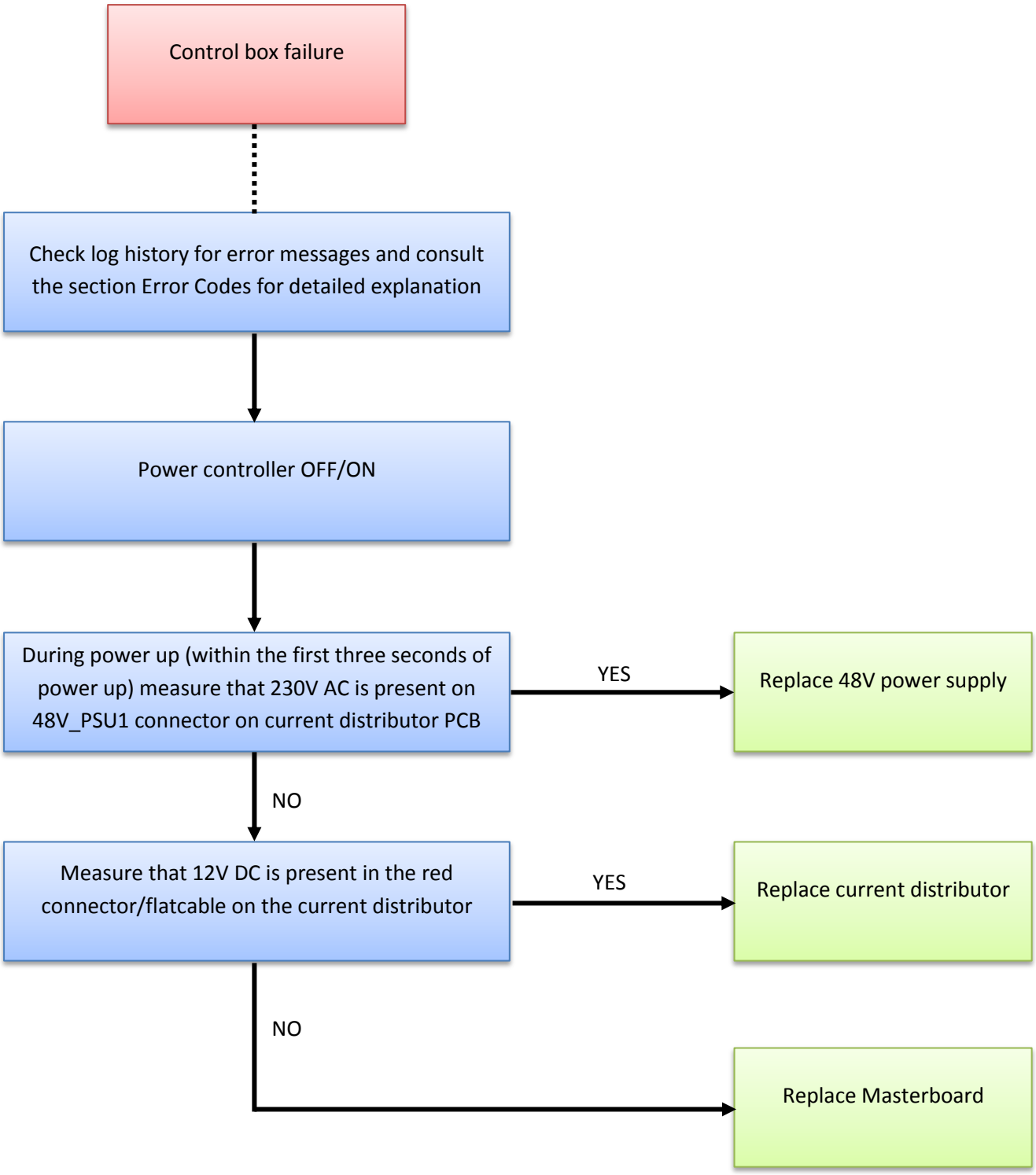
5.2.3 Force limit protective stop

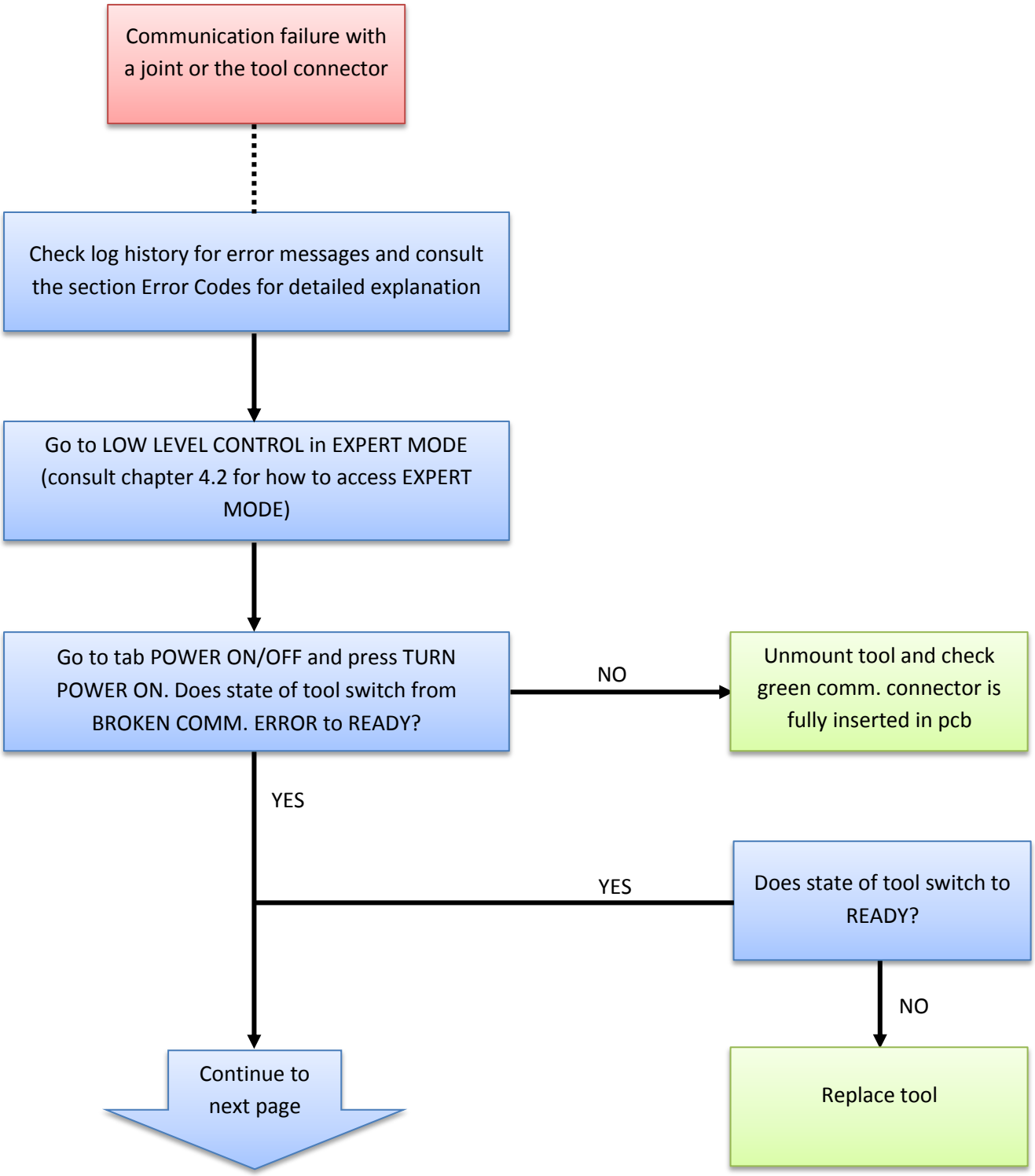


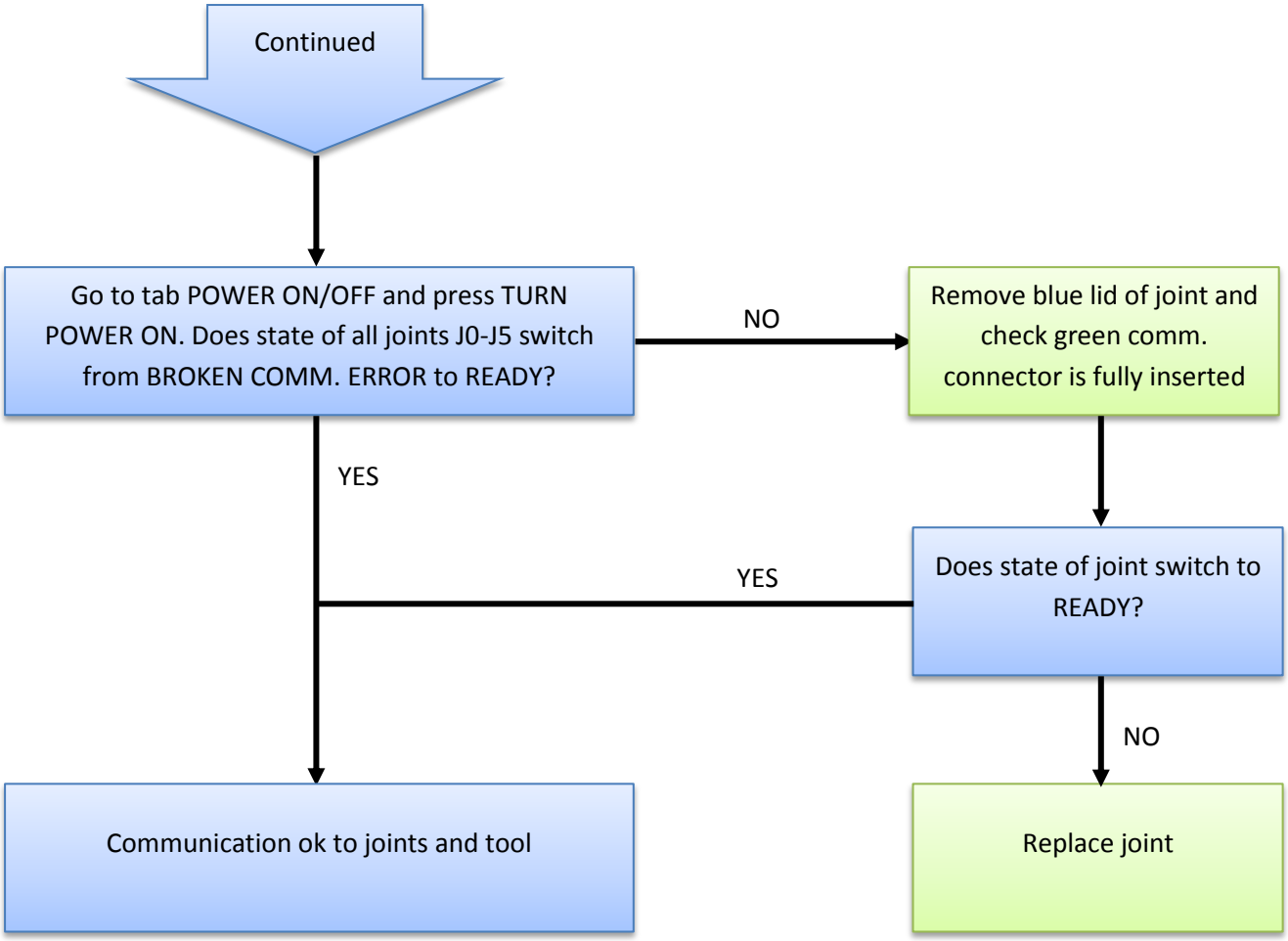
5.2.4 Power on failure in Initializing

If power turns off a few seconds after Robot Power is turned On in the Initializing window, there are many possible causes for this phenomenon.

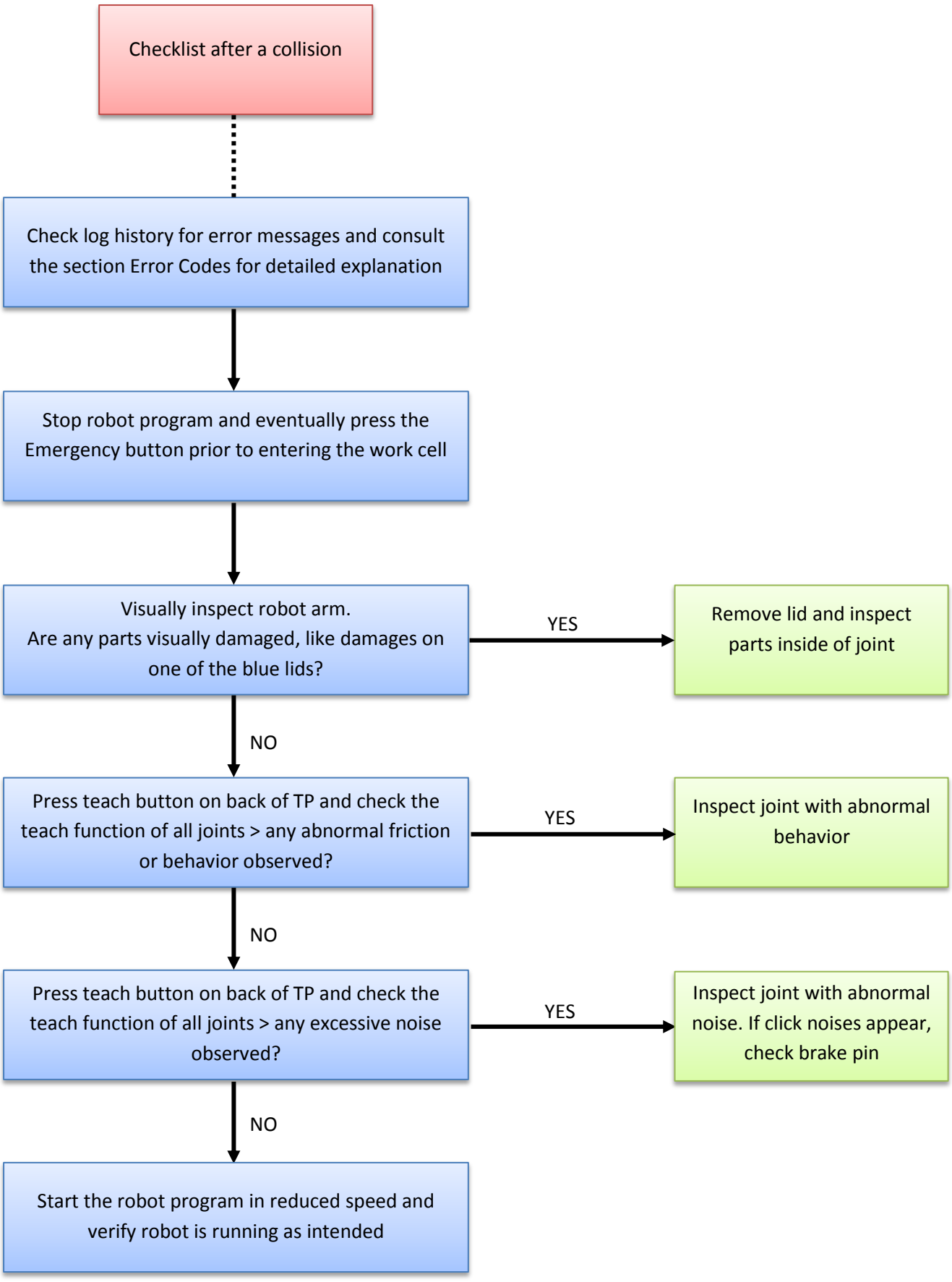
Most likely it is a control box failure or a communication failure with a joint or the tool.



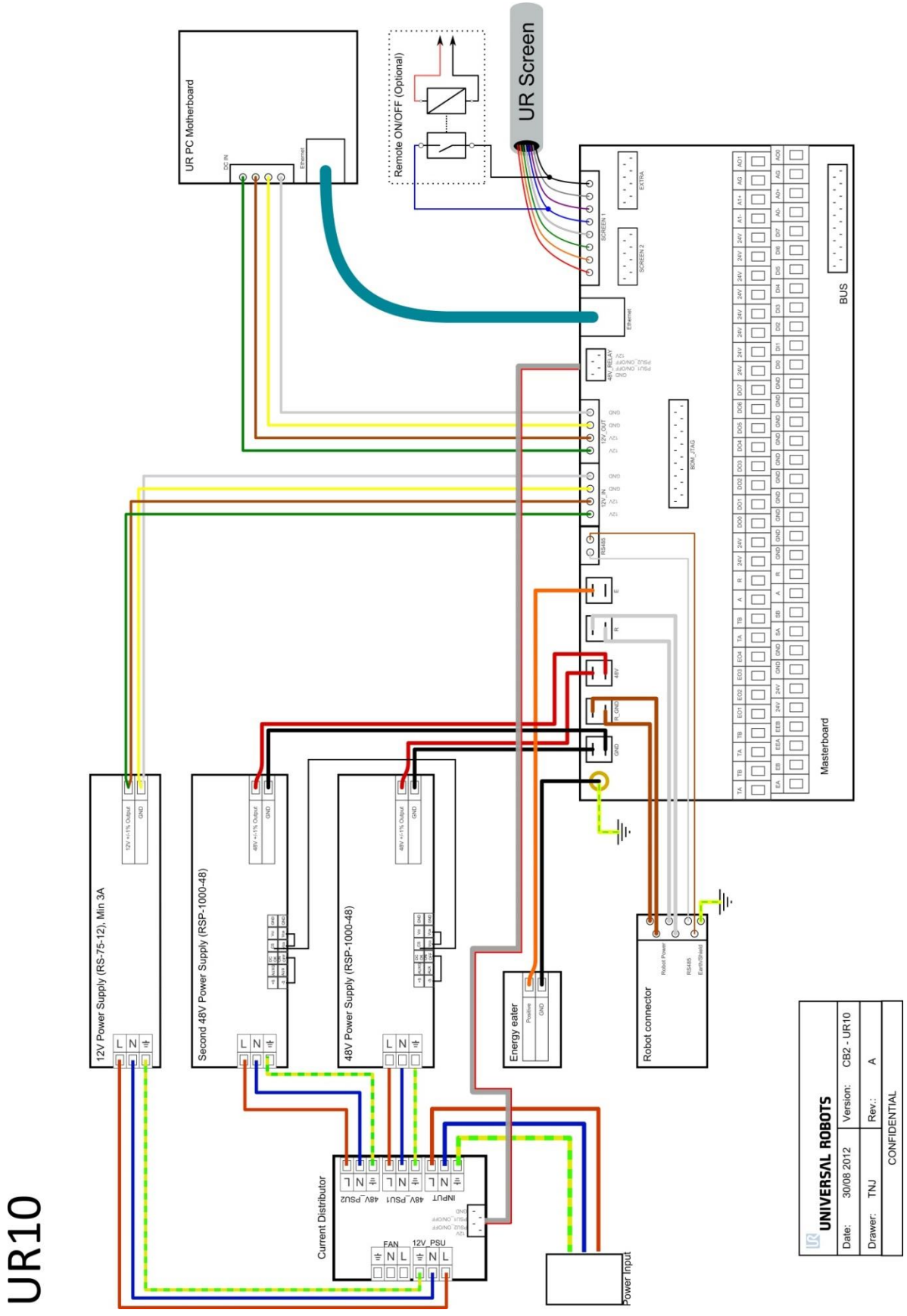

Communication failure with a joint or the tool connector
Check log history for error messages and consult the section Error Codes for detailed explanation
Go to LOW LEVEL CONTROL in EXPERT MODE (consult chapter 4.2 for how to access EXPERT MODE)
Go to tab POWER ON/OFF and press TURN POWER ON. Does state of tool switch from BROKEN COMM. ERROR to READY?
NO
Unmount tool and check green comm. connector is fully inserted in pcb
YES
YES
Does state of tool switch to READY?
NO
Replace tool
Continue to next page


Continued
Go to tab POWER ON/OFF and press TURN POWER ON. Does state of all joints J0-J5 switch from BROKEN COMM. ERROR to READY?
NO
Remove blue lid of joint and check green comm. connector is fully inserted
YES
Does state of joint switch to READY?
YES
NO
Communication ok to joints and tool
Replace joint

5.2.5 Checklist after a collision



5.3 Schematic drawing



6. Spare parts

6.1 Spare part list

Item no.	Item designation
Controller:	
122550	Controller excl. Teach Pendant UR10
122810	Controller incl. Teach Pendant UR10
106700	Euromap E67 kit (includes E67 module + bypass plug + cable)
123670	Euromap E67 cable 6m
122090	Teach Pendant incl. Touchscreen and power cables UR5 and UR10
122500	Controller excl. Teach Pendant UR5
122805	Controller incl. Teach Pendant UR5
122600	Motherboard kit
122700	Masterboard kit
177002	Power Supply Unit 12V
177003	Power Supply Unit 48V
172080	Current distributor PCB
122740	Energy Eater incl. Fan
173203	Cable f. Teach Pendant
170400	Touchscreen display
164204	Emergency stop switch
107601	Power button incl. wire bundle
171021	Flash card
171030	RAM module
164219	Wire bundle controller output UR5
164200	Teach button incl. connectors
177503	Filter kit for controller
Robot arm:	
111010	UR10 robotarm stand-alone
122102	Joint Size 2 Wrist 1 UR10
122202	Joint Size 2 Wrist 2 UR10
122302	Joint Size 2 Wrist 3 UR10
122104	Joint Size 4 Base UR10
122204	Joint Size 4 Shoulder UR10
122304	Joint Size 3 Elbow UR10
122060	Tool Mounting Bracket UR10
122070	Base Mounting Bracket UR10
103402	Lid set Lowerarm UR10 incl. Seal (3x lid for size 2)
103404	Lid set Upperarm UR10 incl. Seal (2x lid for size 4 + 1x lid for size 3)

103310	Sealing set UR10, external
105201	Screw set UR10
164061	Wire bundle Upperarm UR10
164062	Wire bundle Lowerarm UR10
Accessories:	
131510	Bracket f. mounting robotarm UR10 (Item & Bosch profile)
132033	Bracket f. mounting Teach Pendant
132407	Bracket f. mounting Controller
173100	Cable f. tool external

6.2 Tool part list

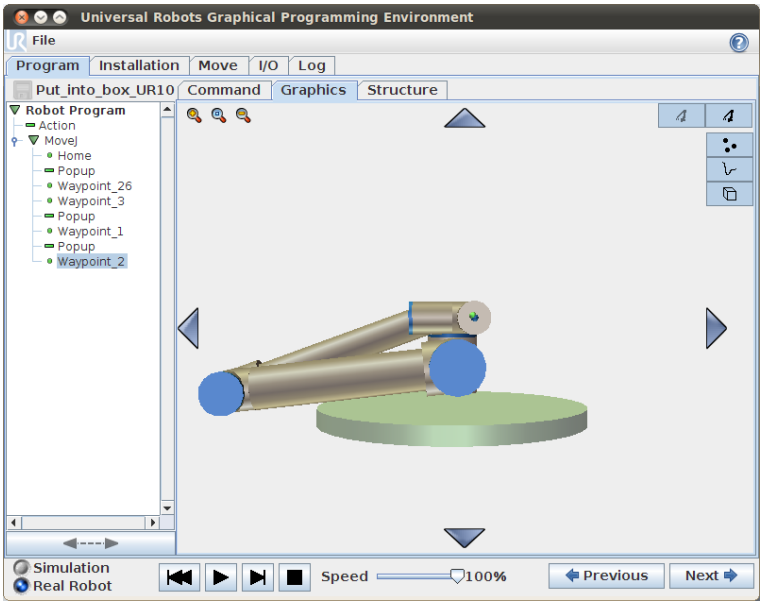
Item no.	Item designation
Tools:	
109010	Tool kit UR10 (kit includes all of the below part no.'s)
109101	Spanner Hex 5,5mm
109102	Spanner Hex 7,0mm
109110	Spanner Hex 10,0mm
109103	Screwdriver torx T10
109104	Allen key torx T10
109105	Torque wrench Hex 5,5mm Size 1 and Size 2
109106	Torque wrench Hex 7,0mm Size 3
109107	Torque wrench Hex 10,0mm Size 4
109109	Calibration tool size 3
108001	Bypass cable (for setting joint-ID)

7. Packing of robot

Packing of robot and controller box for shipment

- Remove any external tooling and external electrical connections.

- Load program *Put_into_box_ur10.urp* and follow instructions while removing mounting bolts.



While robot folds together, hold a piece of bubble wrap between Shoulder joint and wrists.

Note: If robot cannot run or power is not available, it is possible to manually release the brakes for each joint individually and pack the robot accordingly. For brake release, see chapter 3.1.2.

- Power down, disconnect power and disconnect robot arm from controller.

- Pack robot arm and Controller box in designated boxes.

8. Changelog

8.1 Changelog

Date	Revision	Action	Changes
3. jan 2013	UR10_en_1.0	Added	First revision 1.0 released
24 may 2013	UR10_en_1.0.1	Added	Company details added
		Added	Description of new Magic Files added
		Corrected	Spare part list corrected
3. sep 2013	UR10_en_1.0.2	Corrected	Error code descriptions corrected
		Added	Illustration for base plate connections added
22. feb 2014	UR10_en_2.0.1	Added	Changelog added
		Corrected	Error code C115: Cause and remedy corrected
		Corrected	Spare part list: new part numbers implemented
		Added	Spare part list: additional part numbers added
		Corrected	New company address added
31. mar 2014	UR10_en_2.0.2	Added	Additional instructions on replacement of tool flange are added, as additional parts have been added to tool flange